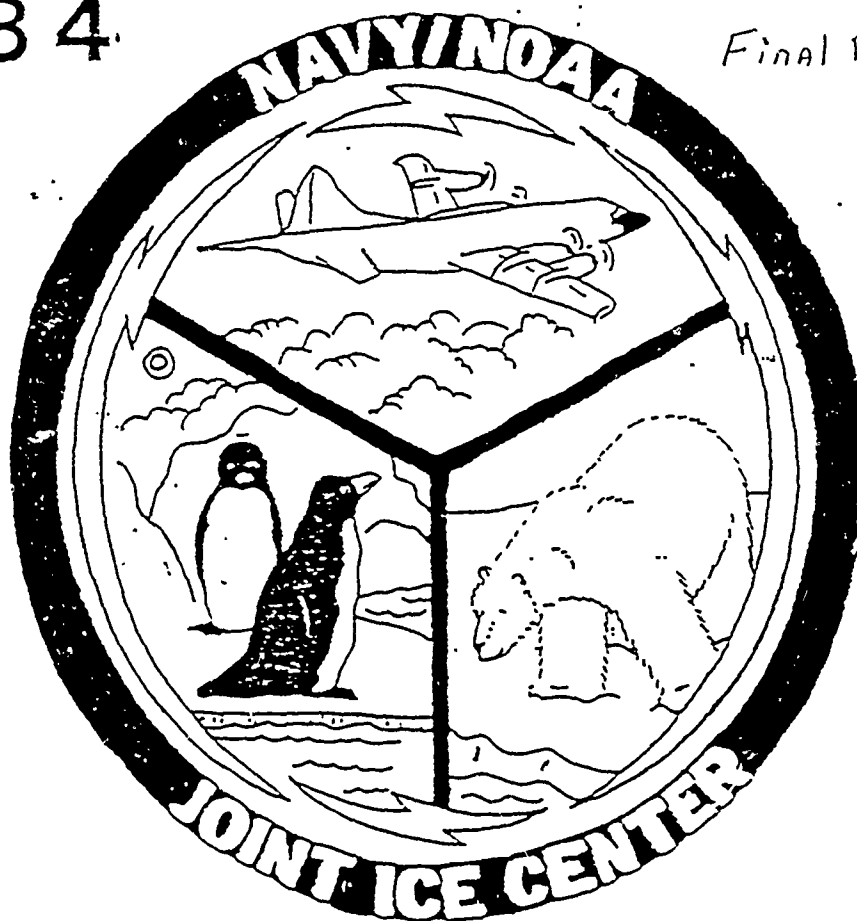


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ICE OBSERVATION HANDBOOK 1984

Final Report



JUL 26 1985

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FOREWORD

This handbook is provided as an aid in understanding the characteristics of sea ice, and the techniques and procedures utilized in sea ice observation and reporting. It is hoped that this handbook will aid in the interpretation of all Navy/NOAA Joint Ice Center sea ice information provided to our varied users.

INTRODUCTION

The Navy/NOAA Joint Ice Center was formed in 1976 and is tasked with providing sea ice analysis, forecasting, and reconnaissance services to the Department of Defense, U.S. and foreign government agencies as well as academic institutions, commercial concerns and the general public. Colocated with the Naval Polar Oceanography Center (NAVPOLAROCEN) the Joint Ice Center is staffed by U.S Navy and NOAA personnel.

The Ice Observation Handbook, a compendium of aerial, ship, and shore codes and terminology, has been designed primarily for use by the ice observer in the field and by those activities routinely making use of sea ice products. Complete explanations of all NAVPOLAROCEN ice codes, as well as, a complete explanation of the World Meteorological Organization (WMO) ice codes, abbreviations, and glossary of the ice terminology are included. Additionally, graphic aides defining sea ice thickness matrix are contained for reference.

As resource development increases in the polar regions, so will ship traffic and forecasting. Reliable observations provide input into the analysis and forecasting that supports operations in the Arctic and Antarctic. The information contained in this handbook should clarify communications between the observer/forecaster, and the field user by standardizing reporting procedures and eliminating confusion regarding current codes and terminology. ←

A handbook of this type is naturally only as good as the feedback received; your comments as to the usefulness of this handbook, and recommendations for its future improvement are whole-heartedly solicited.

M. J. Finerty Jr.
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NOTE: This Ice Observation Handbook supercedes all previous editions of this manual.



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CHAPTER 1

1.1 STAGES OF SEA ICE DEVELOPMENT.

Because of its salinity seawater does not begin to freeze until it reaches approximately -1.8 degrees Celsius. The exact freezing point depends upon the exact salinity. The higher the salinity, the lower the freezing point. The thickness and physical characteristics of sea ice vary greatly with its age and stage of development.

1.1.1 NEW ICE As sea water begins to freeze individual ice crystals, spicules, and platelets begin to form. These unconsolidated ice formations are mixed within the upper layers of the sea and have no given form. Depending upon the conditions under which this ice is formed (calm, choppy, snowing, etc) various different forms of New ice are found.

1.1.1.1 SLUSH - formed during snowfall

1.1.1.2 FRAZIL - earliest stage of new ice

1.1.1.3 GREASE - formed under calm conditions

1.1.1.4 SHUGA - formed under agitated conditions

1.1.1.5 NILAS - Nilas is a later stage of New ice in which the ice has consolidated into a thin sheet. This sheet is very flexible and will conform to swell. There are two forms of Nilas.

1.1.1.5.1 DARK NILAS (0-5 cm)

1.1.1.5.2 LIGHT NILAS (5-10 cm)

1.1.2 YOUNG ICE Continued cold temperatures will cause additional freezing of the ice at the bottom and along the sides of the ice. This will increase the thickness of the ice and change its color. When the ice is between 10 and 30 cm thick it is known as Young ice. There are two categories of Young ice based on the color and thickness of the ice.

1.1.2.1 GREY ICE - (10-15 cm)

1.1.2.2 GREY-WHITE ICE (15-30 cm)

1.1.3 FIRST YEAR ICE As the thickness of the ice exceeds 30 cm the ice is then known as First Year ice. While there is no upper limit on the thickness of First Year ice it normally does not exceed 2 meters. It should be noted that all of these thickness categories pertain to level, undeformed ice only. Deformed First Year ice can reach a thickness in excess of 20 meters.

1.1.3.1 FIRST YEAR THIN - (30-70 cm)

1.1.3.2 FIRST YEAR MEDIUM - (70-120 cm)

1.1.3.3 FIRST YEAR THICK - (greater than 120 cm)

1.1.4 OLD ICE Old ice is ice that has survived at least one summer's melt. There are no thickness limits on Old ice. It is differentiated from other ages of ice based on chemical and physical characteristics rather than by thickness. Old ice is considerably less saline than First Year Ice and as a result is considerably stronger. The topography of Old ice is more weathered than that found on First Year Ice. There are two subdivisions of Old ice.

1.1.4.1 SECOND YEAR ICE - ice that has survived one summer's melt.

1.1.4.2 MULTIYEAR ICE - ice that has survived two or more melt seasons.

TABLE 1

STAGES OF DEVELOPMENT

<u>ABBREVIATION</u>	<u>STAGE OF DEVELOPMENT</u>	<u>THICKNESS</u>
NEW	New, Frazil, Slush, Shuga, Grease	0-10cm (0-4in)
N	Dark Nilas	0-5cm (0-2in)
N	Light Nilas	5-10cm (2-4in)
G	Gray	10-15cm (4-6in)
GW	Gray-white	15-30cm (6-12in)
FL	First Year Thin	30-70cm (12-28in)
FM	First Year Medium	70-120cm (28-47in)
FT	First Year Thick	120-200cm (47-80in)
SY	Second Year	More than 2m (80in)
MY	Multiyear	More than 2m (80in)

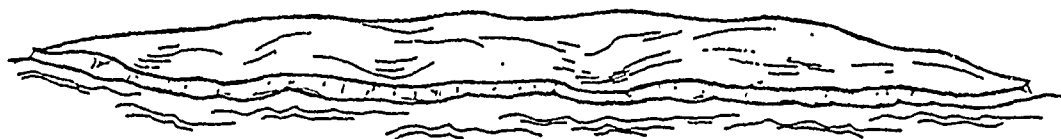
1.2 CHARACTERISTICS OF SEA ICE

The characteristics of sea ice fall into two major categories, floe size and topography.

1.2.1 FLOE SIZE As sea ice forms, it does not remain as a solid sheet of ice. The effects of wind, sea, swell, currents and tides all act to break the ice into pieces. The pieces have various names depending upon their size but are generally known as floes. Table 1.2 below describes the sizes of ice pieces and Figure 1-1 provides a comparison table for identifying floe size. Detailed descriptions of these terms are found in Chapter 2.

TABLE 1.2
FLOE SIZE

<u>ABBREVIATION</u>	<u>NAME</u>	<u>DIMENSIONS</u>
PK	Pancake	3m (10ft)
CK	Brash, Small Cake, Cake	20m (66ft)
SF	Small Floe	20-100m (66-328 ft)
MF	Medium Floe	100-500m (328-1640 ft)
BF	Big Floe	500m-2km (1640ft-1.1nm)
VF	Vast Floe	2-10km (1.1-5.4nm)
GF	Giant Floe	More than 10km (5.4nm)



GIANT FLOE: Greater Than 10KM (5NM)



VAST FLOE: 2-10KM (1-5NM)*



SMALL CITY



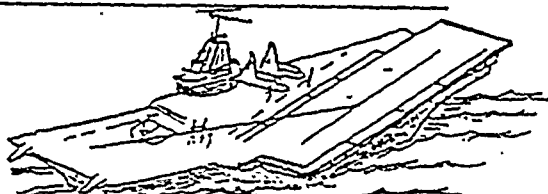
BIG FLOE: 500-2,000M (1,500' - 1 NM)*



GOLF COURSE



MEDIUM FLOE: 100-500M (300' - 1,500')*



AIRCRAFT CARRIER DECK



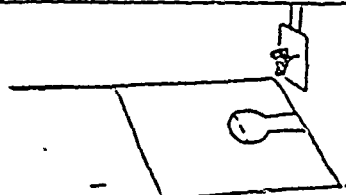
SMALL FLOE: 20-100M (60' - 300')*



CITY BLOCK



ICE CAKE: 2-20M (6' - 60')*



HALF OF A BASKETBALL COURT



SMALL ICE CAKE: LESS THAN 2M (6')



POOL TABLE TOP

(* APPROXIMATELY)

FIGURE 1-1

1.2.2 SEA ICE TOPOGRAPHY Sea ice, as stated before, does not remain a single smooth sheet. Not only do the forces of wind and sea break the ice into pieces, it also deforms the ice. Additionally, the seasonal changes in the weather will effect the topography of the ice.

1.2.2.1 Rafting and Ridging. When wind and sea forces the ice together or against a coast it will deform. This deformation takes two basic forms: rafting and ridging. Rafting is most prevalent in new and young ice. Rafting occurs when a portion of the ice sheet is forced up on top of another portion. Ridging, on the other hand occurs in grey-white and thicker stages of ice. In ridging, the ice is fractured and crushed into small fragments which are lifted up and pushed down rather than sliding on top of the adjacent ice sheet. A new ridge can be easily identified by its sharp peaks and steep slopes. Weathered ridges have smoother contours and shallower slopes and may be snow covered. Weathered ridges will still maintain significant height. Aged ridges are less pronounced in height and appear more as a rise or hill in an otherwise flat surface. Below each ridge will be a corresponding keel of sea ice. Figure 1-2 illustrates rafting and ridging.

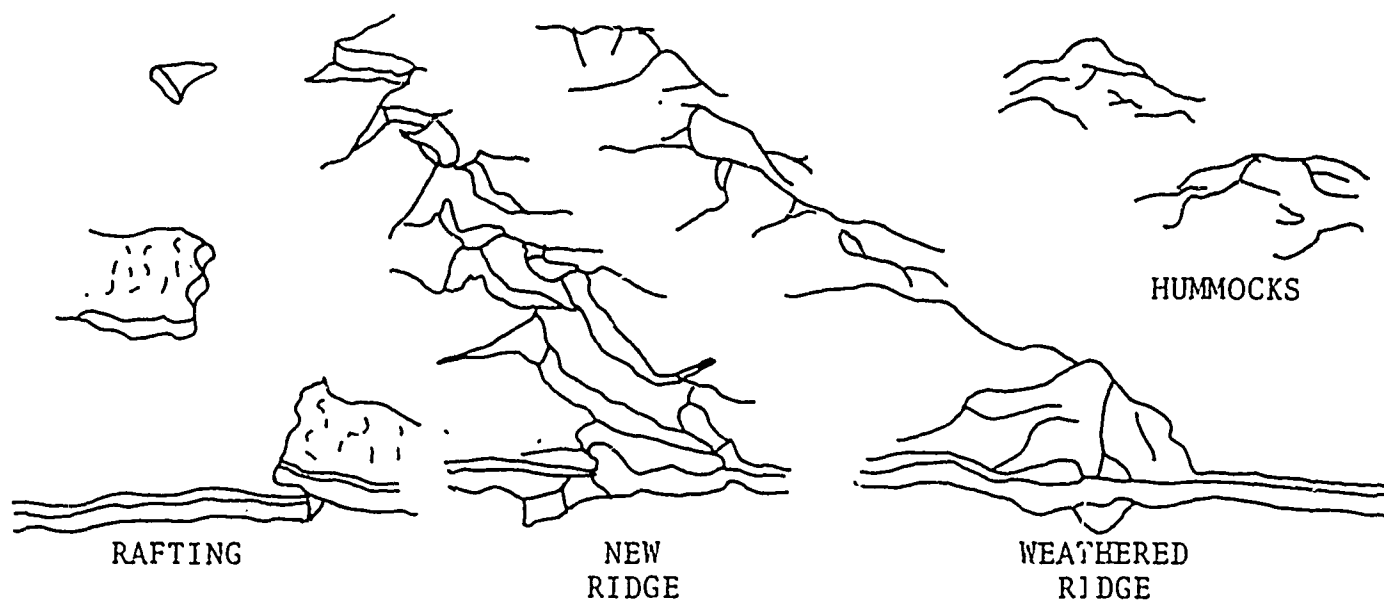


FIGURE 1-2

1.2.2.2 MELT PONDS, THAW HOLES, AND ROTTEN ICE As the melting process begins, the snow on the surface and the surface layers melt. This thin layer of water rapidly absorbs solar radiation and the melting process accelerates. The water follows the topography of the ice and settles into melt ponds. The water continues to absorb solar radiation and the heating and melting is isolated to the melt pond. This melting may continue until all the ice under the melt pond is melted. This is known as a thaw hole. Ice that is honeycombed with thaw holes is known as rotten ice. If melt continues the ice will disintegrate and totally melt. If the melting process is not complete and the ice survives, the ice will refreeze. Refrozen melt ponds and drainage channels are characteristics that are used to visually positively identify old ice.

1.3 DETERMINATION OF CONCENTRATION.

All sea ice concentrations in this manual are expressed in tenths of areal coverage. For instance, 3 tenths of ice coverage means that 30 percent of the surface of the water is covered with ice. Concentrations of less than one tenth (a trace) are reported as open water. The use of oktas (eighths) to report ice concentrations has been discontinued.

1.3.1 Area of Consideration Sea ice concentrations should be observed within one kilometer of the ship or aircraft. Any attempt to estimate the concentration beyond this limit may result in an overestimation of the concentration due to the slant range of vision. Under no circumstances should an estimate of the sea ice concentration on the horizon be attempted.

1.3.2 Concentration Boundary's Whenever sea ice concentrations vary within the area of observation an effort should be made to provide the location of the concentration boundaries. Figure 1-3 contains representative examples of sea ice concentrations.

REPRESENTATIVE ICE CONCENTRATIONS



LESS THAN 1 TENTH
OPEN WATER



1 TENTH
VERY OPEN PACK



2-3 TENTHS
VERY OPEN PACK



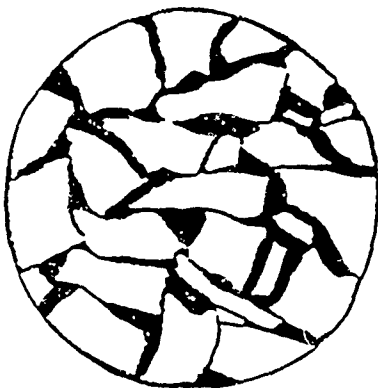
4 TENTHS
OPEN PACK



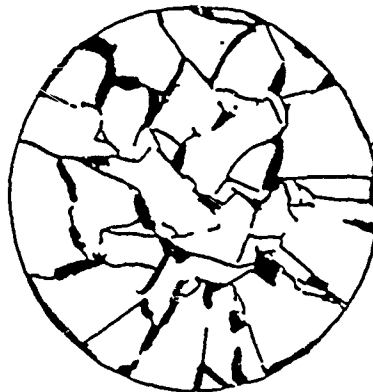
5 TENTHS
OPEN PACK



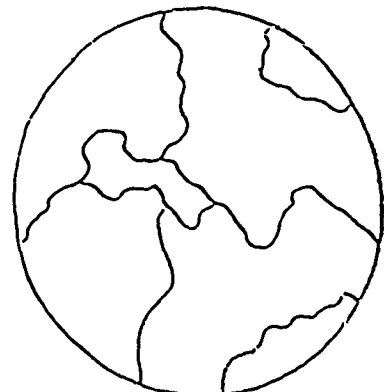
6 TENTHS
OPEN PACK



7-8 TENTHS
CLOSE PACK



9 TENTHS
VERY CLOSE PACK

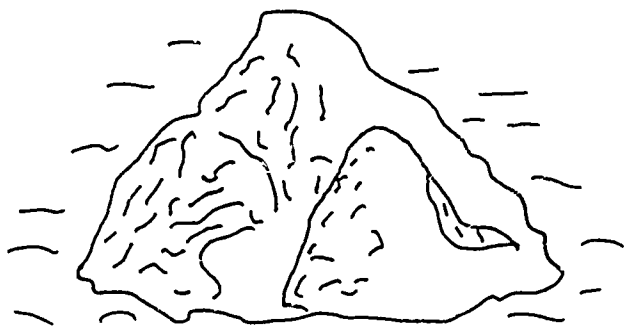


10 TENTHS
COMPACT OR
CONSOLIDATED
PACK

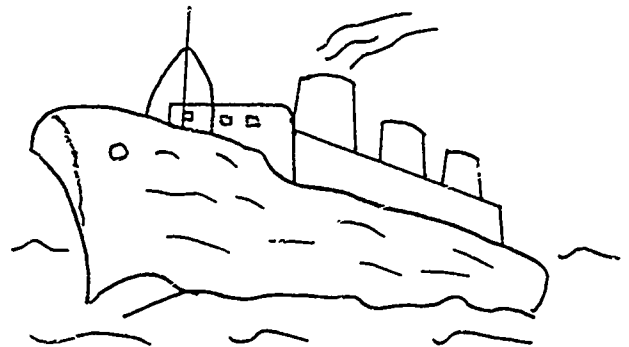
FIGURE 1-3

1.4 ICE OF LAND ORIGIN

Ice that has been formed on land as a result of the compaction of snow into glaciers is frequently found in certain regions of the polar regions. In these regions the glaciers flow to the sea and form ice shelves. The ice shelves calve off icebergs or ice islands. Because of their large mass and unusual strength icebergs are a hazard to navigation. Figure 1-4 provides size comparison for ice of land origin.



ICEBERG



SHIP



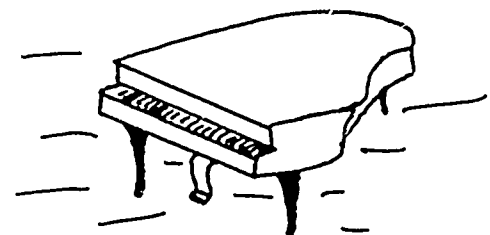
BERGY BIT



SMALL COTTAGE



GROWLER



PIANO

FIGURE 1-4

SEA ICE TERMINOLOGY AND SYMBOLOGY

2.1 WORLD METEOROLOGICAL ORGANIZATION SEA ICE TERMINOLOGY

International cooperation in the standardization of sea ice terminology has been accomplished through the World Meteorological Organization (WMO) since 1947. The following are the most recent terms and symbols that are used internationally to describe ice.

Aged ridge: Ridge which has undergone considerable weathering. These ridges are best described as undulations.

Anchor ice: Submerged ice attached or anchored to the bottom, irrespective of its formation.

Area of weakness: A satellite observed area in which either the ice concentration or the ice thickness is significantly less than that in the surrounding areas. Because the condition is satellite observed, a precise quantitative analysis is not always possible, but navigation conditions are significantly easier than in surrounding areas.

Bare ice: Ice without snow cover.

Belt: A large feature of ice arrangement, longer than it is wide, 1 km or greater in width.

Bergy bit: A large piece of floating glacier ice, generally showing less than 5 meters above sea-level but more than 1 meter and normally about 100-300 square meters in area.

Bergy water: An area of freely navigable water in which glacier ice is present in concentrations less than 1/10. There may be sea ice present, although the total concentration of all ice shall not exceed 1/10.

Beset: Situation of a vessel surrounded by ice and unable to move.

Big floe: (See Floe).

Bight: Extensive crescent-shaped indentation in the ice edge, formed by either wind or current.

Brash ice: Accumulations of floating ice made up of fragments not more than 2 meters across, the wreckage of other forms of ice.

Bummock: From the point of view of the submariner, a downward projection from the underside of the ice canopy; the counterpart of a hummock.

Calving: The breaking away of a mass of ice from an ice wall, ice front, or iceberg.

Close ice: Floating ice in which the concentration is 7/10 to 8/10, composed of floes mostly in contact.

Compacted ice edge: Close, clear-cut ice edge compacted by wind or current; usually on the windward side of an area of ice.

Compacting: Pieces of floating ice are said to be compacting when they are subjected to a converging motion, which increases ice concentration and/or produces stresses which may result in ice deformation.

Compact ice: Floating ice in which the concentration is 10/10 and no water is visible.

Concentration: The ratio expressed in tenths describing the amount of the sea surface covered by ice as a fraction of the whole area being considered. Total concentration includes all stages of development that are present, partial concentration may refer to the amount of a particular stage or of a particular form of ice and represents only a part of the total.

Concentration boundary: A line approximating the transition between two areas of drift ice with distinctly different concentrations.

Consolidated ice: Floating ice in which the concentration is 10/10 and the floes are frozen together.

Consolidated ridge: A ridge in which the base has frozen together due to melting or other processes.

Crack: Any fracture of fast ice, consolidated ice, or a single floe which has been followed by separation ranging from a few centimeters to one meter.

Dark nilas: Nilas which is under 5cm in thickness and is very dark in color.

Deformed ice: A general term for ice which has been squeezed together and in places forced upwards (and downwards). Subdivisions are rafted ice, ridged ice, and hummocked ice.

Difficult area: A general qualitative expression to indicate in a relative manner, that the severity of ice conditions prevailing in an area is such that navigation in it is difficult.

Diffuse ice edge: Poorly defined ice edge limiting an area of dispersed ice; usually on the leeward side of ice.

Diverging: Ice fields or floes in an area are subjected to diverging or dispersive motion, thus reducing ice concentration and/or relieving stress in the ice.

Drift ice: Term used in a wide sense to include any area of sea ice other than fast ice no matter what form it takes or how it is dispersed. When concentrations are high, i.e. 7/10 or more, drift ice may be replaced by the term pack ice.

Dried ice: Sea ice from the surface of which melt-water has disappeared after the formation of cracks and thawholes. During the period of drying, the surface whitens.

Easy area: A general qualitative expression to indicate in a relative manner, that ice conditions prevailing in an area are such that navigation is not difficult.

Fast ice: Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea level. Fast ice may be formed in situ from sea water or by freezing of drift ice of any stage to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (second-year, or multi-year). If it is thicker than about 2m above sea-level it is called an ice shelf.

Fast ice boundary: The ice boundary at any given time between fast ice and drift ice.

Fast-ice edge: The demarcation at any given time between fast ice and open water.

Finger rafting: Type of rafting whereby interlocking thrusts are formed, each floe thrusting "fingers" alternately over and under the other. Common in nilas and grey ice.

Firn: Old snow which has recrystallized into a dense material. Unlike ordinary snow, the particles are to some extent joined together; but, unlike ice, the air spaces in it still connect with each other.

First year ice: Sea ice of not more than one winters growth developing from young ice; thickness 30cm-2m. May be subdivided into thin first year ice/white ice, medium first year ice, and thick first year ice.

Flaw: A narrow separation zone between drift ice and fast ice, where the pieces of ice are in a chaotic state; it forms when drift ice shears under the effect of a strong wind or current along the fast-ice boundary (cf. shearing).

Flaw lead: A passage-way between drift ice and fast ice which is navigable by surface vessels.

Flaw polynya: A polynya between drift ice and fast ice.

Floating ice: Any form of ice found floating in water. The principle kinds of floating ice are lake ice, river ice, and sea ice; which form by the freezing of water at the surface, and glacier ice (ice of land origin) formed on land or in an ice shelf. The concept includes ice that is stranded or grounded.

Floe: Any relatively flat piece of sea ice 20m or more across. Floes are subdivided according to horizontal extent as follows:

Giant: Over 10km across
Vast: 2-10km across
Big: 500-2,000m across
Medium: 100-500m across
Small: 20-100m across

Floeberg: A massive piece of sea ice composed of a hummock, or a group of hummocks frozen together and separated from any ice surroundings. It may typically protrude up to 5 meters above sea-level.

Floe-bit: A relatively small piece of sea ice, normally not more than 10m across composed of a hummock(s) or part of a ridge(s) frozen together and separated from any surroundings. It typically protrudes up to 2m above sea level.

Flooded ice: Sea ice which has been flooded by melt-water or river water and is heavily loaded by water and wet snow.

Fracture: Any break or rupture through very close ice, compact ice, consolidated ice, fast ice, or a single floe resulting from deformation processes. Fractures may contain brash ice and/or be covered with nilas and/or young ice. Length may vary from a few meters to many kilometers.

Fracture zone: An area which has a great number of fractures.

Fracturing: Pressure process whereby ice is permanently deformed, and rupture occurs. Most commonly used to describe breaking across very close ice, compact ice, and consolidated ice.

Frazil ice: Fine spicules or plates of ice, suspended in water.

Friendly ice: From the point of view of the submariner, an ice canopy containing many large skylights or other features which permit a submarine to surface. There must be more than ten such features per 30 nautical miles (56 km) along the submarine's track.

Frost smoke: Fog-like clouds due to the contact of cold air with relatively warm water, which can appear over openings in the ice, or leeward of the ice edge, and which may persist while ice is forming.

Giant Floe: (see floe).

Glacier: A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principle forms of glacier are: Inland ice sheets, ice shelves, ice streams, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

Glacier ice: Ice in, or originating from, a glacier, whether on land or floating on the sea as icebergs, bergy bits, or growlers.

Glacier tongue: Projecting seaward extension of a glacier, usually afloat. In the Antarctic, glacier tongues may extend over many tens of kilometers.

Grease ice: A later stage of freezing than frazil ice when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matte appearance.

Grey ice: Young ice 10-15cm thick. Less elastic than nilas and breaks on swell. Usually rafts under pressure.

Grey-white ice: Young ice 15-30cm thick. Under pressure more likely to ridge than raft.

Grounded hummock: Hummocked, grounded ice formation. There are single grounded hummocks and lines (or chains) of grounded hummocks.

Grounded ice: Floating ice which is aground in shoal water (cf. stranded ice.)

Growler: Smaller piece of ice than a bergy bit or floeberg, often transparent but appearing green or almost black in color, extending less than 1m above the sea surface and normally occupying an area of about 20 square meters.

Hostile ice: From the point of the submariner, an ice canopy containing no large skylights or other features which permit a submarine to surface.

Hummock: A hillock of broken ice which has been forced upwards by pressure. May be fresh or weathered. The submerged volume of broken ice under the hummock, forced downwards by pressure, is termed a bummock.

Hummocked ice: Sea ice piled haphazardly one piece over another to form an uneven surface. When weathered, has the appearance of smooth hillocks.

Hummocking: The pressure process by which sea ice is forced into hummocks. When the floes rotate in the process it is termed screwing.

Iceberg: A massive piece of ice of greatly varying shape, protruding more than 5m above sea-level, which has broken away from a glacier, and may be afloat or aground. Icebergs may be described as tabular, domeshaped, sloping, pinnacle, weathered, or glacier bergs.

Iceberg tongue: A major accumulation of icebergs projecting from the coast, held in place by grounding and joined together by fast ice.

Ice blink: A whitish glare on low clouds above an accumulation of distant ice.

Ice bound: A harbor, inlet, etc. is said to be ice-bound when navigation by ships is prevented on account of ice, except possibly with the assistance of an icebreaker.

Ice boundary: The demarcation at any given time between fast ice and drift ice or between areas of drift ice of different concentrations (cf. ice edge).

Ice breccia: Ice of different stages of development frozen together.

Ice cake: Any relatively flat piece of sea ice less than 20m across.

Ice canopy: Drift ice from the point of view of the submariner.

Ice cover: The ratio of an area of ice of any concentration to the total area of sea surface within some large geographic locale; this locale may be global, hemispheric, or prescribed by a specific oceanographic entity such as Baffin Bay or the Barents Sea.

Ice edge: The demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting. It may be termed compacted or diffuse (cf. ice boundary)

Ice field: Area of floating ice consisting of any size of floes, which is greater than 10km across (cf. patch).

Icefoot: A narrow fringe of ice attached to the coast, unmoved by tides and remaining after the fast ice has moved away.

Ice-free: No sea ice present. There may be some ice of land origin present (cf. open water)

Ice front: The vertical cliff forming the seaward face of an ice shelf or other floating glacier varying in height from 2-50m or more above sea-level (cf. ice wall)

Ice island: A large piece of floating ice protruding about 5m above sea-level which has broken away from an Arctic ice shelf, having a thickness of 30-50m and an area of from a few thousand square meters to 500sq km or more, and usually characterized by a regular undulating surface which gives it a ribbed appearance from the air.

Ice isthmus: A narrow connection between two areas of very close or compact pack ice. It may be difficult to pass, yet sometimes being part of a recommended route.

Ice jam: An accumulation of broken river ice or sea ice caught in a narrow channel.

Ice keel: From the point of view of the submariner, a downward projecting ridge on the underside of the ice canopy; the counter part of a ridge. Ice keels may extend as much as 50m below sea surface.

Ice limit: Climatological term referring to the extreme minimum or extreme maximum extent of the ice edge in any given month or period based on observations over a number of years. Term should be preceded by minimum or maximum (cf. mean ice edge).

Ice of land origin: Ice formed on land or in an ice shelf, found floating in water. The concept includes ice that is stranded or grounded.

Ice patch: An area of floating ice less than 10km across.

Ice port: An embayment in an ice front, often of a temporary nature, where ships can moor alongside and unload directly onto the ice shelf.

Ice rind: A brittle shiny crust of ice formed on a quiet surface by direct freezing or from grease ice, usually in water of low salinity. Thickness to about 5cm. Easily broken by wind or swell, commonly breaking into rectangular pieces.

Ice shelf: A floating ice sheet of considerable thickness showing 2-50m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land glaciers. Limited areas may be aground. The seaward edge is termed an ice front.

Ice under pressure: Ice in which deformation processes are actively occurring and hence a potential impediment or danger to shipping.

Ice Wall: An ice cliff forming the seaward margin of a glacier which is not afloat. An ice wall is aground, the rock basement being at or below sea-level (cf. ice front).

Jammed Brash Barrier: A strip or narrow belt of new, young or brash ice (usually 100-500m wide), formed at the edge of either drift or fast ice or at the shore. It is heavily compacted mostly due to wind action and may extend 2-20m below the surface but does not normally have appreciable topography. Jammed Brash Barrier may disperse with changing winds but can also consolidate to form a strip of unusually thick ice as compared to the surrounding pack ice.

Lake ice: Ice formed on a lake, regardless of observed location.

Large fracture: More than 500m wide.

Large ice field: An ice field over 20km across.

Lead: Any fracture or passageway through sea ice which is navigable by surface vessels.

Level Ice: Sea ice which is unaffected by deformation.

Light nilas: Nilas which is more than 5cm in thickness and rather lighter in color than dark nilas.

Mean ice edge: Average position of the ice edge in any given month or period based on observations over a number of years. Other terms which may be used are mean maximum ice edge and mean minimum ice edge (cf. ice limit).

Medium first-year ice: First-year ice 70-120cm thick.

Medium floe: (see Floe).

Medium fracture: 200 to 500m wide.

Medium ice field: An ice field 15-20km across.

Multi-year ice: Old ice up to 3m or more thick which has survived at least two summer's melt. Hummocks even smoother than in second-year ice, and the ice is almost salt free. Color, where bare, is usually blue. Melt pattern consists of large interconnecting irregular puddles and a well-developed drainage system.

New ice: A general term for recently formed ice which includes frazil ice, grease ice, slush, and shuga. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

New ridge: Ridge newly formed with sharp peaks and slope of sides usually 40 degrees. Fragments are visible from the air at low altitudes.

Nilas: A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matte surface and is up to 10cm in thickness. May be subdivided into dark nilas and light nilas.

Nip: Ice is said to nip when it forcibly presses against a ship. A vessel so caught, though undamaged, is said to have been nipped.

Old ice: Sea ice which has survived at least one summer's melt, thickness up to 3m or more. Most topographic features are smoother than on first-year ice. May be subdivided into second-year and multi-year ice.

Open ice: Floating ice in which the concentration is 4/10 to 6/10 with many leads and polynyas, and the floes are generally not in contact with one another.

Open water: A large area of freely navigable water in which sea ice is present in concentrations less than 1/10. When there is no sea ice present, the area should be termed ice free.

Pack ice: Concentration of 7/10 or more of drift ice (cf. Drift ice).

Pancake ice: Predominantly circular pieces of ice from 30cm - 3m in diameter, and up to about 10 cm in thickness, with raised rims due to the pieces striking up against one another. It may be formed on a slight swell from grease ice, shuga, or slush or as a result of the breaking of ice rind, nilas, or under severe breaking of ice rind, nilas, or under severe conditions of swell or waves, of grey ice. It also sometimes forms at some depth, at an interface between water bodies of different physical characteristics, from where it floats to the surface; its appearance may rapidly cover wide areas of water.

Polynya: Any non-linear shaped opening enclosed in ice. Polynyas may contain brash ice and/or be covered with new ice, nilas, or young ice; submariners refer to these as skylights. Sometimes the polynya is limited on one side by the coast and is called a shore polynya or by fast ice and is called a flaw polynya. If it recurs in the same position every year, it is called a recurring polynya.

Puddle: An accumulation of melt-water on ice, mainly due to the melting of snow, but in the more advanced stages also to the melting ice. Initial stage consists of patches of melted snow.

Rafted ice: Type of deformed ice formed by one piece of ice overriding another (cf. finger rafting).

Rafting: Pressure processes whereby one piece of ice overrides another. Most common in the new and young ice (cf. finger rafting)

Ram: An underwater ice projection from an ice wall, ice front, iceberg, or floe. Its formation is usually due to a more intensive melting and erosion of the unsubmerged part.

Recurring polynya: A polynya which recurs in the same position every year.

Ridge: A line or wall of broken ice forced up by pressure. May be fresh or weathered. The submerged volume of broken ice under a ridge, forced downwards by pressure is termed an ice keel.

Ridged ice: Ice piled haphazardly one piece over another in the form of ridges or walls. Usually found in first-year ice (cf. ridging).

Ridged ice zone: An area in which much ridged ice with similar characteristics has formed.

Ridging: The pressure process by which sea ice is forced into ridges.

River ice: Ice formed on a river, regardless of observed location.

Rotten ice: Sea ice which has become honeycombed and which is in an advanced state of disintegration.

Rubble field: An area of extremely deformed sea ice of unusual thickness formed during the winter by the motion of pack ice against, or around a protruding rock, islet or other obstruction.

Sastrugi: Sharp, irregular ridges formed on a snow surface by wind erosion and deposition. On drift ice the ridges are parallel to the direction of the prevailing wind at the time they were formed.

Sea ice: Any form of ice found at sea which has originated from the freezing of sea water.

Second-year ice: Old ice which has survived only one summer's melt, thickness up to 2.5m and sometimes more. Because it is thicker than first-year ice, it stands higher out of water. In contrast to multi-year ice, summer melting produces a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish-blue.

Shearing: An area of ice subject to shear when the ice motion varies significantly in the direction normal to the motion, subjecting the ice to rotational forces. These forces may result in phenomena similar to flaw.

Shear ridge: An ice ridge formation which develops when one ice feature is grinding past another. This type of ridge is more linear than those caused by pressure alone.

Shear ridge field: Many shear ridges side by side.

Shore lead: A lead between drift ice and the shore, or between drift ice and an ice front.

Shore melt: Open water between the shore and the fast ice, formed by melting and/or due to river discharge.

Shore polynya: A polynya between drift ice and the coast, or between drift ice and an ice front.

Shore ice ride-up: A process by which ice is pushed ashore as a slab.

Shuga: An accumulation of spongy white ice lumps, a few cm across; they are formed from grease ice or slush and sometimes from anchor ice rising to the surface.

Skylight: From the point of view of the submariner, thin places in the ice canopy, usually less than 1m thick and appearing from below as relatively light, translucent patches in dark surroundings. The undersurface of a skylight is normally flat. Skylights are called large if big enough for a submarine to attempt to surface through them (120m), or small if not.

Slush: Snow that is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

Small Floe: (see Floe).

Small fracture: 50 to 200m wide

Small ice cake: An ice cake less than 2m across.

Small ice field: An ice field 10 to 15km across.

Snow-covered ice: Ice covered with snow.

Snowdrift: An accumulation of wind blown snow deposited in the lee of obstructions or heaped by wind eddies.

Standing floe: A separate floe standing vertically or inclined and enclosed by rather smooth ice.

Stranded ice: Ice which has been floating and has been deposited on the shore by retreating high water.

Strip: Long narrow area of floating ice, about 1km or less in width, usually composed of small fragments detached from the main mass of ice, and run together under the influence of wind, swell, or current.

Tabular berg: A flat-topped iceberg. Most tabular bergs form by calving from an ice shelf and show horizontal banding (cf. ice island).

Thaw holes: Vertical holes in sea ice formed when surface puddles melt through to the underlying water.

Thick first-year ice: First-year ice over 120cm thick.

Thin first-year ice/white ice: First-year ice 30-70 cm thick. May sometimes be subdivided into first stage (30-50cm thick) and second stage (50-70cm thick).

Tide crack: Crack at the line of junction between an immovable ice foot or ice wall and fast ice, the latter subject to rise and fall of the tide.

Vast floe: (see Floe).

Very Close ice: Floating ice in which the concentration is 9/10 to less than 10/10.

Very open ice: Floating ice in which the concentration is 1/10 to 3/10 and water preponderates over ice.

Very small fracture: 1 to 50 m wide.

Very weathered ridge: Ridge with peaks very rounded, slope of sides usually 20-30 degrees.

Water sky: Dark streaks on the underside of low clouds, indicating the presence of water features in the vicinity of sea ice.

Weathered ridge: Ridge with peaks slightly rounded and slope of sides usually 30-40 degrees. Individual fragments are not discernable.

Weathering: Processes of ablation and accumulation which gradually eliminate irregularities in an ice surface.

White ice: (see Thin first-year ice/white ice).

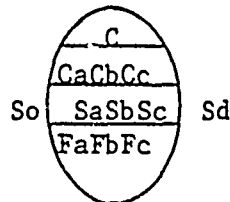
Young coastal ice: The initial stage of fast ice formation consisting of nilas or young ice. Its width varying from a few meters up to 100-200m from the shoreline.

Young ice: Ice in the transition stage between nilas and first-year ice, 10-30cm in thickness. May be subdivided into grey and grey-white ice.

2.2 INTERNATIONAL (WMO) SYSTEM OF SEA ICE SYMBOLOGY

The international (WMO) system of sea ice symbols is intended for use on synoptic and prognostic ice charts which are issued by national ice centers, either by radio facsimile or by mail, primarily to serve operational marine activities. Charts transmitted by ice observing units to users should also follow the international system.

2.2.1 Egg Elements The basic data concerning concentration, stage of development (with amounts of up to three age classes) and form of ice are contained in a simple oval form (the egg; see appendix 2 for example).



2.2.1.1 Total Concentration (C) of ice in the area, reported in tenths (see code table in appendix 1). The reporting of concentration ranges may be made as indicated in appendix 2.

2.2.1.2 Partial Concentrations (CaCbCc) of sea ice are reported in tenths relative to the thickness of sea ice. (Ca) is the thickest and (Cc) the least thick. Less than 1/10 is not reported. 10/10 of one stage of development is reported by C, Sa, Fa, or C, Sa, Fp and Fs.

2.2.1.3 Stages of Development (SaSbSc) of sea ice are reported in tenths with (Sa) reporting the thickest stage of development. (Sb) indicates the next thickest stage and (Sc) the third thickest stage of development. The three stages with the highest concentration should generally be reported in SaSbSc. An additional stage of development can be reported in (Sd). A stage of development thicker than indicated in (Sa) but less than 1/10 in concentration is reported in (So).

2.2.1.4 Forms of sea ice (F) are indicated in one of two ways.

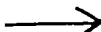

2.2.1.4.1 (FaFbFc) indicates the form of ice (floe size) corresponding to the stages identified in (SaSbSc) respectively (see code table 10 in Appendix 3). Absence of information on any one of these forms is indicated with an (X) at the corresponding position. Should icebergs be present in sufficient numbers to have a concentration (Fa) is reported as a (9) and the appropriate symbol for (Sa) and (Ca) as depicted in example (5) in appendix 2.

2.2.1.4.2 (FpFs) indicate the Predominant floe size (Fp) and the Secondary floe size (Fs). Predominant and secondary floe sizes are reported independently from Sa, Sb, Sc (see code table 10 in Appendix 3). Should only a predominant floe size be identified (Fs) will not be reported (see example 4 in appendix 2).

2.2.2 Symbols for dynamic process and supplementary procedures (optional).

2.2.2.1 Compacting

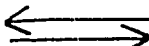
2.2.2.1.1 Symbol: 

2.2.2.1.2 Supplementary procedure:
Compacting:  (degree) 


degree:

- 1-Slight compacting
- 2-Considerable compacting
- 3-Strong compacting

2.2.2.2 Diverging 

2.2.2.3 Shearing 


2.2.2.4 Drift


2.2.2.4.1 Symbol: 

2.2.2.4.2 Supplementary procedure:

Drift: (in tenths of knots)
(e.g. 15-1.5 knots)

2.2.3 Symbols and supplementary procedures (optional) for depicting water openings.


2.2.3.1 Crack  (symbol indicating presence of cracks in the area)


2.2.3.2 Crack  (symbol for crack in a specific location)

2.2.3.3 Lead

2.2.3.3.1 Symbol:  or 

2.2.3.3.2 Supplementary procedures (optional):

Lead  (width) (width of lead in meters or kilometers, e.g. 100-300 m)

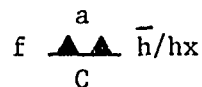
2.2.3.4 Frozen lead  (the orientation of the crosslines may be varied to distinguish them from other hatching lines)

Polynya



2.2.4 Symbols for topography features

2.2.4.1 Ridges/hummocks



Concentration (areal coverage) C in tenths. Frequency f in number per nautical mile (f is an alternative for C). Mean height \bar{h} and maximum height hx are expressed in decimeters (table 18 in appendix 3). The data for C, f, \bar{h} , and hx are added where known. An optional element "a" can be used to indicate the type of topography (ridging) present (see table 3 in appendix 3).

2.2.4.2 Rafting



Concentration C is indicated where known.

2.2.4.3 Jammed brash barrier



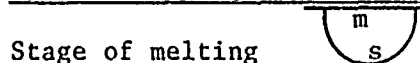
2.2.5. Symbol for ice thickness

2.2.5.1 Thickness measured E (E in centimeters)

2.2.5.2 Thickness estimated E (example: 35)

2.2.5.3 When more than one measurement has been taken, both mean and maximum thickness are reported as 30/40x.

2.2.6 Symbol for stage of melting



Stage of melting

(see code table 6 in Appendix 6 for ms)

2.2.7 Symbol for surface features

2.2.7.1 Snow cover C s2

Concentration C (areal coverage) in tenths. Snow depth s2 (see table 9 in Appendix 3).

2.2.7.2 The orientation of the symbol will show the direction of sastrugi as indicated below:



2.2.8 Symbols for ice of land origin

2.2.8.1 The number *n* of bergs from WMO Code 2877 (see table 7, Appendix 3). The appropriate triangle symbol from table 2.1 below. The day of the month YY sighted.


n 
YY

Table 2.1

















	Actual number of bergs	
	known	unknown
Growler and/or bergy bit		
Iceberg (size unspecified)		
Iceberg, small		
Iceberg, medium		
Iceberg, large		
Iceberg, very large		
Tabular berg is indicated by adding a horizontal line through any of the above, e.g.		
Ice island		
Radar target (suspected berg)	 	

Table 2.2

Size	Height (m)	Length (m)
Growler & Bergy Bit	up to 5	less than 15
Iceberg, small	6-15	16-60
Iceberg, medium	16-45	61-122
Iceberg, large	46-75	123-213
Iceberg, very large	over 75	more than 213

Sizes refer to the above water portion only. If height and length of a berg in meters (m) fall into a different size classification, use the larger size. Dimensions (in kilometers) of a tabular berg or ice island may be indicated beneath the symbol. Iceberg size specification are those established by the International Ice Patrol Service.

2.2.8.2 Ice of sea origin

Floeberg



2.2.9 Symbols for limits

Table 2.3

Undercast



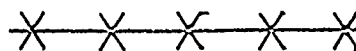
Limit of visual observations



Limit of radar observations



Ice edge by radar



Observed edge or boundary
(Visual or satellite)



Estimated edge or boundary



2.2.10 Symbol for strips and patches

Strips and patches

~ C

Concentration C in tenths of ice within area of strips and patches (optional addition). The symbol ~ C is placed within the main "oval" symbol in the section reserved for "Form of ice" (see example 6 in appendix 2).

2.2.11. Supplementary procedures for indicating total concentration

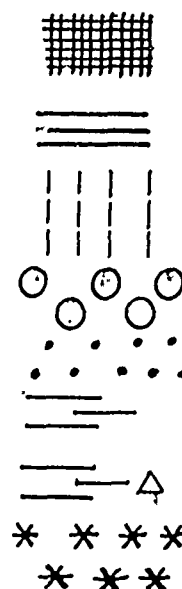
In order to facilitate readability of the chart, ice-covered areas may be hatched according to total ice concentration. Hatching may be applied to all areas of ice concentration or only to some of them. Whenever hatching has been applied, the hatching symbols as shown in the next section of this chapter shall be used. No international rules are given for the spacing or thickness of the hatching lines; the thickness may be the same throughout all hatched areas, or may vary in the sense that thickest lines are used for areas of thicker ice.

2.2.11.1 Symbols or the hatching of total concentration of sea ice

Table 2.4

Concentration

10/10	Consolidated ice (compact)	}
9-10/10	Very close ice	
7-8/10	Close ice	
4-6/10	Open ice (Line spacing is twice that of close ice)	
1-3/10	Very open ice	
<1/10	Open water	
0	Ice Free	
	Bergy water	
	New ice	



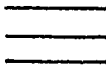
When scattered stars are used to indicate the presence of new ice, reporting the actual amount of this stage of development as a component of the total concentration is optional.

Fast ice  or  with national variation of hatching to show stage of development

The symbol for fast ice may also be used on individual giant floes in cases where there are no risks of the floes being interpreted as fast ice.

2.2.12 Additional symbols for regional use

Symbol adopted for use in the Baltic Sea area:

Level ice  (Line spacing is twice that
of close ice).

CHAPTER 3

SEA ICE SUPPORT AND OBSERVATIONS

3.1 TAILORED SEA ICE SUPPORT

Tailored sea ice support is provided by the Joint Ice Center to ships operating in and near the ice on a twice weekly basis. This support is supplied to the ships in message format rather than in chart format.

3.1.1 MESSAGE FORMAT. Sea ice analyses and forecasts are provided as alphanumeric messages. The messages are a combination of plain language descriptions of ice concentration and age and latitude/longitude pairs describing the location of ice edge and other ice features. Figure 3-1 is a sample sea ice analysis and sample sea ice support message describing the analysis. It is important to remember that not all features of the ice edge or the inner-pack concentration boundaries can be described with latitude/longitude pairs and still retain a reasonable message length. There are a number of abbreviations that are used in sea ice support messages. A listing of these abbreviations and their meanings are found in Appendix 3.

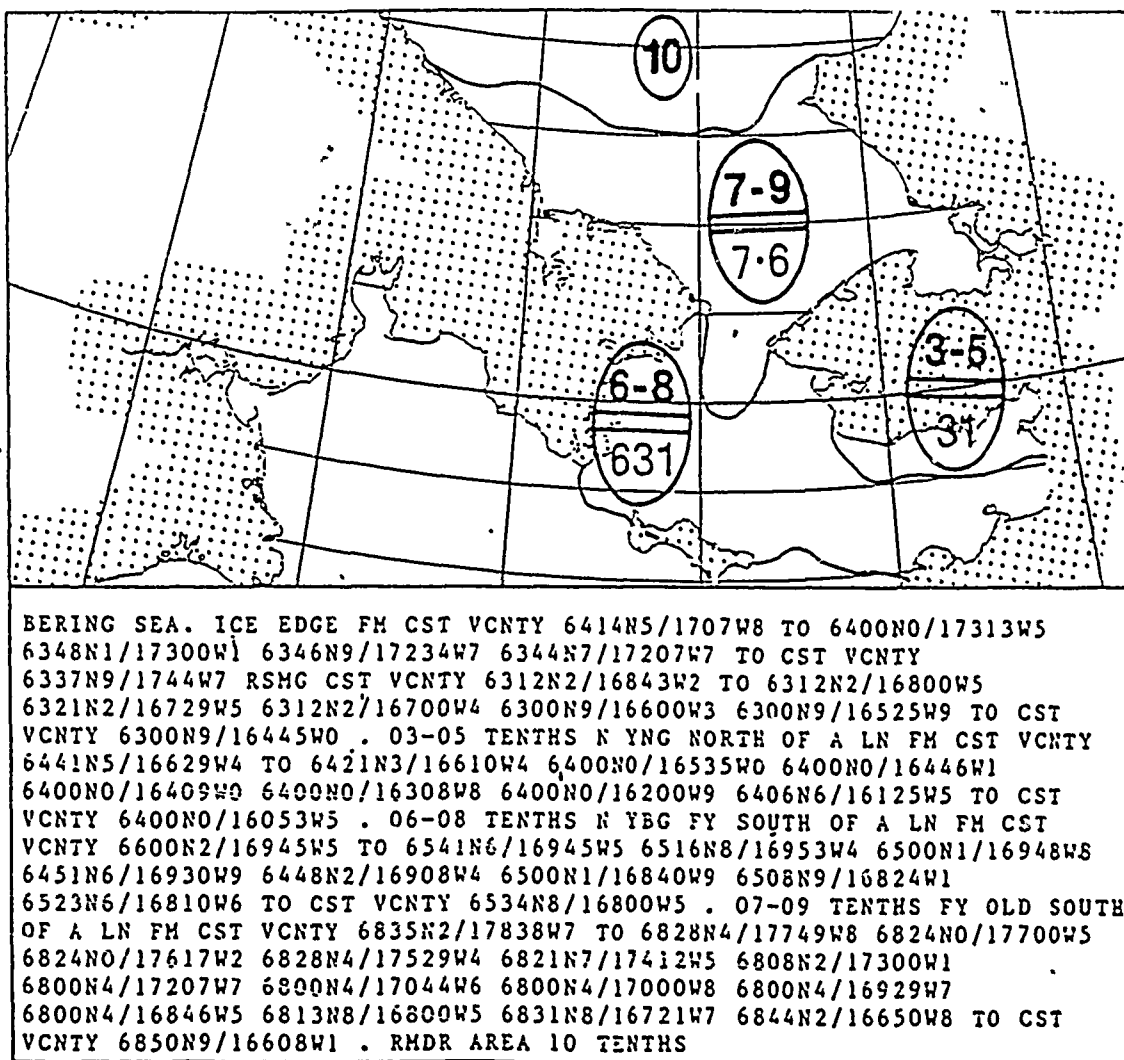


FIGURE 3-1

3.1.2 MESSAGE CONTENT. There are two basic types of ship support messages:

3.1.2.1 ICE EDGE ONLY - this message contains only the position of the sea ice edge which is defined as the limit of one tenth or more of ice. It is designed for ships that are concerned with ice avoidance and do not intend to operate in the ice.

3.1.2.2 ICE EDGE WITH INNER PACK CONDITIONS - this message contains inner pack concentrations and ages as well as the ice edge.

3.1.3 REQUESTING SERVICES AND COMMUNICATIONS.

3.1.3.1 DEPARTMENT OF DEFENSE. DOD and U.S. Coast Guard users should request sea ice support services by letter to the Naval Polar Oceanography Center or by Autodin message addressed to NAVPOLAROCENCEN Suitland, MD. Support messages will be forwarded via Autodin.

3.1.3.2 ALL OTHERS. All other users should request sea ice support by letter or telex from the JOINT ICE CENTER. The Joint Ice Center does not have its own telex capability and utilizes the telex connections of the National Weather Service. The following circuits may be utilized:

CIRCUIT	ANSWERBACK
RCA 248376	248376 OBSW UR
TRT 197683	197683 KWBC UT
WU 89406	NW OBS MHTS

The Joint Ice Center does not have any funding for commercial Telex support. Consequently users desiring to receive support via commercial Telex must contact the Joint Ice Center to work out communications arrangements.

3.2 SHIP SEA ICE OBSERVATIONS.

Systematic sea ice observations from ships operating in or near sea ice are invaluable to the Joint Ice Center. They serve not only as one of the few ground truth data sources but serve to "anchor" the satellite derived sea ice analysis. Shipboard observations should be made at least every six hours even if the ship is hove to or beset in ice. If overall sea ice conditions are changing rapidly observations should be made more frequently. Shipboard observers can provide more accurate data on the height of ridges, thickness of the ice, and snow cover than can be provided by the aerial ice observer. There are two basic formats for reporting sea ice observations. The first is the ICE group that is appended to the WMO ship synoptic weather observation. The second format is the more detailed Ship Ice Observation Code (IISS).

3.2.1 SHIP SYNOPTIC WEATHER CODE ICE GROUP. The ICE group of the ship synoptic weather code is located at the end of section 2 of the code and has the format:

ICE + $\left\{ \begin{array}{c} \text{plain language} \\ \text{or} \\ \text{ciSibiDizi} \end{array} \right\}$

3.2.1.1 Code letter ci - Concentration or arrangement of sea ice

ci — Concentration or arrangement of sea ice

Code figure

0	No sea ice in sight		
1	Ship in open lead more than 1.0 nautical mile wide, or ship in fast ice with boundary beyond limit of visibility		
2	Sea ice present in concentrations less than 3/10 (3/8), open water or very open pack ice	Sea ice concentration is uniform in the observation area	Ship in ice or within 0.5 nautical mile of ice edge
3	4/10 to 6/10 (3/8 to less than 6/8), open pack ice		
4	7/10 to 8/10 (6/8 to less than 7/8), close pack ice		
5	9/10 or more, but not 10/10 (7/8 to less than 8/8), very close pack ice		
6	Strips and patches of pack ice with open water between	Sea ice concentration is not uniform in the observation area	
7	Strips and patches of close or very close pack ice with areas of lesser concentration between		
8	Fast ice with open water, very open or open pack ice to seaward of the ice boundary		
9	Fast ice with close or very close pack ice to seaward of the ice boundary		
/	Unable to report, because of darkness, lack of visibility, or because ship is more than 0.5 nautical mile away from ice edge		

3.2.1.1.1 The purpose of the first code figure (0) is to establish in relation to code zi (code figure figure 0) and code figure bi whether the floating ice that is visible is only ice of land origin.

3.2.1.1.2 The possible variations in sea-ice concentration and arrangement within an area of observation are almost infinite. However, the field of reasonably accurate observation from a ship's bridge is limited. For this reason, and also because minor variations are of temperature significance, the choice of concentrations and arrangements has been restricted for reporting purposes to those representing significantly different conditions from a navigational point of view. The code figures 2-9 have been divided into two sections depending on:

3.2.1.1.2.1 Whether sea-ice concentrations within the area of observation are more or less uniform (code figures 2-5); or

3.2.1.1.2.2 Whether there are marked contrasts in concentrations or arrangement (code figures 6-9).

3.2.1.2 Code letter si - Stage of development

S_i — Stage of development

Code
figure

- 0 New ice only (frazil ice, grease ice, slush, shuga)
- 1 Nilas or ice rind, less than 10 cm thick
- 2 Young ice (grey ice, grey-white ice), 10-30 cm thick
- 3 Predominantly new and/or young ice with some first-year ice
- 4 Predominantly thin first-year ice with some new and/or young ice
- 5 All thin first-year ice (30-70 cm thick)
- 6 Predominantly medium first-year ice (70-120 cm thick) and thick first-year ice (> 120 cm thick) with some thinner (younger) first-year ice
- 7 All medium and thick first-year ice
- 8 Predominantly medium and thick first-year ice with some old ice (usually more than 2 metres thick)
- 9 Predominantly old ice
- ! Unable to report, because of darkness, lack of visibility or because only ice of land origin is visible or because ship is more than 0.5 nautical mile away from ice edge

3.2.1.2.1 This table represents a series of increasing navigational difficulties for any given concentration; i.e. if the concentration is, for example, 8/10ths, then new ice would hardly have any effect on navigation while predominantly old ice would provide difficult conditions requiring reductions in speed and frequent course alterations.

3.2.1.2.2 The correlation between the stage of development of sea ice and its thickness is explained in the Guide to Meteorological Instrument and Observing Practices.

3.2.1.3 Code letter bi - Ice of land origin

bi — Ice of land origin

Code
figure

- | | |
|---|--|
| 0 | No ice of land origin |
| 1 | 1-5 icebergs, no growlers or bergy bits |
| 2 | 6-10 icebergs, no growlers or bergy bits |
| 3 | 11-20 icebergs, no growlers or bergy bits |
| 4 | Up to and including 10 growlers and bergy bits — no icebergs |
| 5 | More than 10 growlers and bergy bits — no icebergs |
| 6 | 1-5 icebergs with growlers and bergy bits |
| 7 | 6-10 icebergs with growlers and bergy bits |
| 8 | 11-20 icebergs with growlers and bergy bits |
| 9 | More than 20 icebergs with growlers and bergy bits — a major hazard to navigation |
| / | Unable to report, because of darkness, lack of visibility or because only sea ice is visible |

3.2.1.3.1 This code provides a scale of increasing navigational hazard.

3.2.1.3.2 Growlers or bergy bits, being much smaller and lower in the water than icebergs, are more difficult to see either by eye or radar. This is especially so if there is a heavy sea running. For this reason, code figures 4 and 5 represent more hazardous conditions than code figures 1 through 3.

3.2.1.4 Code letter Di - Bearing of Principal Ice Edge

D₁ — Bearing of principal ice edge

Code figure

- | | |
|---|---|
| 0 | Ship in shore or flaw lead |
| 1 | Principal ice edge towards NE |
| 2 | Principal ice edge towards E |
| 3 | Principal ice edge towards SE |
| 4 | Principal ice edge towards S |
| 5 | Principal ice edge towards SW |
| 6 | Principal ice edge towards W |
| 7 | Principal ice edge towards NW |
| 8 | Principal ice edge towards N |
| 9 | Not determined (ship in ice) |
| / | Unable to report, because of darkness, lack of visibility or because only ice of land origin is visible |

There is no provision in this code for the reporting of distance from the ice edge. It will be assumed by those receiving the report that the bearing has been given to the closest part of the ice edge. From the reported code figures for concentration and stage of development, it will be clear whether the ship is in ice or within 0.5 nautical mile of the ice edge. If the ship is more than 0.5 nautical mile from the ice edge, the ice edge will be assumed to be aligned at right angles to the bearing which is reported.

3.2.1.5 Code letter zi - Present ice situation and trend of conditions over preceeding 3 hours

zi — Present ice situation and trend of conditions over preceding 3 hours

Code
figure

0	Ship in open water with floating ice in sight	
1	Ship in easily penetrable ice; conditions improving	}
2	Ship in easily penetrable ice; conditions not changing	
3	Ship in easily penetrable ice; conditions worsening	
4	Ship in ice difficult to penetrate; conditions improving	}
5	Ship in ice difficult to penetrate; conditions not changing	
6	Ice forming and floes freezing together	
7	Ice under slight pressure	}
8	Ice under moderate or severe pressure	
9	Ship beset	
/	Unable to report — because of darkness or lack of visibility	

Ship in ice

Ship in ice
difficult to
penetrate and
conditions
worsening

3.2.1.5.1 The purpose of this element is to establish:

3.2.1.5.1.1 Whether the ship is in pack ice or is viewing floating ice (i.e. sea ice and/or ice of land origin) from the open sea.

3.2.1.5.1.2 A qualitative estimate, dependent upon the sea ice navigation capabilities of the reporting ship, of the penetrability of the sea ice and of the recent trend in conditions.

3.2.1.5.2 The reporting of the conditions represented by code figures 1-9 can be used to help in the interpretation of reports from the two code tables (concentration ci and stage of development Si).

NOTE: Usage of the term "open water" adjacent to code figure "0" indicates the ship is located in sea ice free water.

3.2.2 SHIP - SHORE SEA ICE LOG. The ship-shore sea ice log is a detailed sea ice observing and reporting code. The specific instructions for completing the log are found in Appendix 4 and should be studied carefully. Be sure to fill in all pertinent information on the form.

3.2.2.1 TRANSMISSION OF REPORTS Observations should be transmitted to the Joint Ice Center as soon as possible after the observation time. For those users who have access to military AUTODIN circuits the observations should be addressed to :

NAVPOLAR OCEAN CEN SUITLAND MD

For users who do not have access to AUTODIN, the reports can be filed through commercial telex addressed to the JOINT ICE CENTER on one of the following circuits:

<u>CIRCUIT</u>	<u>ANSWERBACK</u>
RCA 248376	248376 OBSW UR
TRT 197683	KWBC UT
WU 89406	NW OBS MHTS

3.2.2.1.1 Mandatory groups will always be transmitted. Supplemental groups will be transmitted when the feature's observed.

3.2.2.1.2 Feature groups will be transmitted only if indicated phenomena outside the "spot" can be observed. As many of these groups should be sent as necessary to describe the ice.

3.2.2.1.3 Ship Helicopter observations will be transmitted when the helicopter returns to the ship. These observations will be considered special observations and will be followed by the letters HLCPTR in the transmitted report.

3.2.2.2 DISPOSITION OF RECORDS. Completed log sheets should be mailed monthly to:

U.S. NAVAL OCEANOGRAPHIC OFFICE
CODE 712B
NSTL STATION
BAY ST LOUIS, MS 39522

3.2.2.3 REQUISITIONS OF FORMS. Ship-Shore Ice Log forms may be requisitioned from the Joint Ice Center or the Naval Polar Oceanography Center via letter, message or telephone call. The commercial telephone numbers are 301-763-5972 or 301-763-7154 . The AUTOVON telephone numbers are 293-1111 or 293-2000.

3.3 SHORE SEA ICE OBSERVATIONS.

Shore sea ice observations are made using the Ship-Shore Sea Ice Log. The specific directions for completing this log are found in Appendix 4.

3.3.1 TRANSMISSION OF REPORTS Observations should be transmitted to the Joint Ice Center as soon as possible after the observation time. For those users who have access to military AUTODIN circuits the observations should be addressed to :

NAVPOLAROCEANCEN SUITLAND MD

For users who do not have access to AUTODIN, the reports can be filed through commercial telex addressed to the JOINT ICE CENTER on one of the following circuits:

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CHAPTER 4

AERIAL ICE RECONNAISSANCE

4.1 AERIAL RECONNAISSANCE PROGRAM

The U.S. Navy/NOAA Joint Ice Center Aerial Reconnaissance Program provides the ground truth information necessary to fulfill tailored operational support requirements.

- 4.1.1 Routine Deployments The Aerial Reconnaissance Unit routinely deploys two to three enlisted personnel to:

4.1.1.1 Keflavik Iceland, 01 JUNE - 15 AUGUST

4.1.1.2 Elmendorf AFB, Alaska, 01 AUGUST - 15 SEPTEMBER

4.1.1.3 McMurdo Station, Antarctica, 20 December - 15 February

- 4.1.2 Assignments Personnel are assigned to specific missions in an effort to fulfill two primary goals.

4.1.2.1 Provide an experienced individual with a firm handle on all mission requirements necessary to the success of the operation.

4.1.2.2 Train new personnel in preparation for meeting future mission requirements.

Personnel assigned to these routine deployments listed above provide primary support to Shipping and U.S. Coast Guard icebreaking operations. Aircrew personnel tasked with sea ice observation data collection utilize VP Squadrons P3-C aircraft assets located at Adak, AK and Keflavik, IC. In addition, flights of opportunity are encouraged to supplement scheduled VP support. C-130 aircraft and helicopters are utilized in providing Operation Deep Freeze support. In addition to routine deployments, personnel are assigned to highly classified U.S. Naval and National Oceanic Atmospheric Administration scientific and operational support missions in polar regions.

4.1.3 Aircrew Observer Training Annual training flights onboard VXN-8 RP3-A aircraft provide newly assigned personnel with the required experience in the field. Observers are trained in:

4.1.3.1 Track Planning

4.1.3.2 Sea Ice Identification

4.1.3.3 Observation Techniques

4.1.3.4 Communication Techniques

These annual flights consist of the Breakup Mission in June and the Freezeup Mission in November. Routine places visited are Keflavik, Iceland; Sondrestrom, Greenland; Thule, Greenland and Elmendorf, Alaska. All mission support in addition to routine requirements are funded by the requesting organization. Aircraft availability is also a responsibility of the user group.

4.2 Sea Ice Observation reporting procedures

4.2.1 Sea Ice Observations are recorded on NAVPOLAROCEANCEN SUITLAND AERIAL ICE LOG forms as depicted on the following two pages. A complete breakdown of the Aerial Ice Observation Code is provided with Notes for Part 1 and 2 to clarify usage following the Aerial Ice Log. Following the code breakdown a sample Sea Ice Observation Message is provided.

4.2.2 Observer Support Responsibilities consist of making visual sea ice observations and recording data at five minute intervals. Radar is utilized to locate the ice edge. Sea Surface Temperatures are collected utilizing Expendable Bathermographs. The temperature data is analyzed and reported via Autodin message sent to FNOC Monterey, CA. Coded and Plain Language Sea Ice Messages are sent to the Naval Polar Oceanography Center, Suitland MD.

4.2.2.1 Each five minute observation is plotted on reconnaissance charts for provision of a graphic display of sea ice conditions. The graphic position plot breakdown and example reconnaissance chart depicted provide the same information as the log sheets and the reconnaissance message.

4.2.2.2 The observer's routine procedure is as follows:

4.2.2.2.1 Take observations utilizing log forms.

4.2.2.2.2 Plot data on reconnaissance chart.

4.2.2.2.3 Check data to insure errors have been corrected.

4.2.2.2.4 Draft message, proofread and dispatch.

4.2.2.2.5 Contact NAVPOLAROCEANCEN within 24 hours to insure data as plotted by NPOC is accurate.

NAVPOLOARCEANCEN SUITLAND AERIAL ICE LOG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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<td>57</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>58</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>59</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>60</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>61</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>62</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>63</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>64</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> 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<td>73</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>74</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>75</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>76</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>77</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>78</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>79</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>80</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>81</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>82</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>83</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>84</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>85</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>86</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>87</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>88</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>89</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>90</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>91</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>92</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>93</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>94</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>95</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>96</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>97</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>98</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>99</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>100</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> 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FIGURE 4-1

FLIGHT: ONE
TRACK: TWO
DATE: 02 MAY 1982
TO: Thule, GN
FROM: Keflavik, IC
OBSERVERS: K. Ritley, K. K. 2

U.S. NAVAL POLAR OCEANOGRAPHY CENTER

AERIAL ICE OBSERVATION CODE FEATURE GROUPS

SUPPLEMENTAL GROUPS: (C1111
556, C1111m, C1111p, C1111f, C1111e, C1111s, C1111o, C1111n, C1111u, C1111v, C1111w, C1111x, C1111y, C1111z, C1111aa, C1111ab, C1111ac, C1111ad, C1111ae, C1111af, C1111ag, C1111ah, C1111ai, C1111aj, C1111ak, C1111al, C1111am, C1111an, C1111ao, C1111ap, C1111aq, C1111ar, C1111as, C1111at, C1111au, C1111av, C1111aw, C1111ax, C1111ay, C1111az, C1111ba, C1111bb, C1111bc, C1111bd, C1111be, C1111bf, C1111bg, C1111bh, C1111bi, C1111bj, C1111bk, C1111bl, C1111bm, C1111bn, C1111bo, C1111bp, C1111bq, C1111br, C1111bs, C1111bt, C1111bu, C1111bv, C1111bw, C1111bx, C1111by, C1111bz, C1111ca, C1111cb, C1111cc, C1111cd, C1111ce, C1111cf, C1111cg, C1111ch, C1111ci, C1111cj, C1111ck, C1111cl, C1111cm, C1111cn, C1111co, C1111cp, C1111cq, C1111cr, C1111cs, C1111ct, C1111cu, C1111cv, C1111cw, C1111cx, C1111cy, C1111cz, C1111da, C1111db, C1111dc, C1111dd, C1111de, C1111df, C1111dg, C1111dh, C1111di, C1111dj, C1111dk, C1111dl, C1111dm, C1111dn, C1111do, C1111dp, C1111dq, C1111dr, C1111ds, C1111dt, C1111du, 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PLAIN LANGUAGE

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FIGURE 4-1

4.3 Aerial Ice Observation Code

4.3.1 Message Format

PART I IIHH YrYr MMDD (not transmitted)

GGgg/ QcLaLaLaLa LoLoLoLoLo 0101hhC 55CoCftCfm CflCyCnFpFs Reala2hhx
7WtDwSms 9nGnGnBnB

PART II IIHH YrYrMMDD (not transmitted)

44111 6LiLiLjLj 6LjLjLjLj QaLaLaLaLa LoLoLoLoLo QcLaLaLaLa
LoLoLoLoLo..etc. (C///// 55CoCftCfm CflCyCnFpFs or Plain Language)

4.3.2 MEANING OF SYMBOLS

(All tables referenced below are located in Appendix 5.)

IIHH	Indicator for aerial ice code. (not transmitted)
YrYr	Year. (not transmitted)
MM	Month of year. (not transmitted)
DD	Day of month. (not transmitted)
GG	Hour of observation in Greenwich Mean Time (GMT).
gg	Time of observation in whole minutes.
/	After gg in Part I and columns 67-70 in Part II, a slash is used as a filler. (also used in any column that is unknown or undetermined, see notes Part I (CH4.3.3.4), 5 and 6).
Qc	Quadrant of the globe in which the observation is made (table 1).
LaLaLaLa	Latitude in degrees and minutes where observation is made.
LoLoLoLoLo	Longitude in degrees and minutes where observation is made.
0101	Limits of observation entered to the nearest whole nautical mile.
hh	Altitude of aircraft to the nearest 100 feet up to 9900 feet. Example: 1100 feet would be encoded 11. Altitudes greater than 9900, encode 99.

C Total concentration of all sea ice present (table 2).

55 Indicator for Stage of Development.

Co Concentration of Second-year and/or Multi-year ice present (table 2).

Cft Concentration of First-year Thick ice present (table 2).

Cfm Concentration of First-year Medium ice present (table 2).

Cfl Concentration of First-year Thin ice present (table 2).

Cy Concentration of Gray and/or Gray-white ice present (table 2).

Cn Concentration of Frazil and/or Grease, Slush, Shuga, Ice rind, Dark nilas, Light nilas ice present (table 2).

Fp Primary form of ice present (table 10).

Fs Secondary form of ice present (table 10). If none present encode slash.

Re Extent of all ridging (table 2).

a1 Primary type of topography of the greatest extent (table 3). If two types are in equal extent, report the oldest topography first.

a2 Secondary type of topography, or that topography of the second greatest extent (table 3). If two types are equal in secondary extent, report the oldest of the two types of topography.

h mean height of ridging encoded in meters (table 18), plotted in centimeters.

hx Maximum height of ridging encoded in meters (table 18), plotted in centimeters.

7 Indicator for water features group.

Wt Type of opening in the ice (table 4).

Dw Orientation of water feature reported in Wt (table 5).

S Amount of ice covered by snow (table 2).

ms	Stage of melting. Record the stage of melting from table 6 that best describes the existing situation. In case of equal stages, use the higher code figure. Few and many are to be considered relative terms for the situation observed and do not refer to any specific surface extent.
9	Indicator for ice of land origin.
nGnG	Growlers and bergy bits. Encode the total number of growlers and bergy bits present within the entire range of visibility (table 7).
nBnB	Icebergs. Encode the total number of icebergs present in the entire range of visibility (table 7).
44111	Indicator for Part II descriptive ice conditions.
6	Indicator for data on the type of line or feature being described.
LiLiLjLj	Type of line or feature being described (table 8).
LjLjLjLj	Type of line or feature being described (table 8).

4.3.3 Notes on Part I

4.3.3.1 Part I of the NAVPOLAROCEANCEN Suitland aerial code relates to an area surrounding the point with which the observation is identified. This area should cover one kilometer in all directions from the point. Part II of the code is intended to represent larger-scale features and may or may not include the area which the point of observation represents.

4.3.3.2 No more than FOUR stages of development can be reported per observation. Only the partial concentration of the four stages will be reported. Follow all WMO "EGG" procedures for plotting.

4.3.3.3 If no sea ice is present, "C" shall be encoded as a zero (0) with the remainder of the code deleted for that observation. If sea ice is observed outside the defined area, report it using Part II. When no sea ice is present but ice of land origin is, "C" will be encoded as zero (0) immediately followed by the 9nGnGnBnB code group.

4.3.3.4 If an observation is impossible due to darkness, undercast etc., C will be encoded (/), with the remainder of the code deleted.

4.3.3.5 When able to see through a thin undercast but unable to determine anything but the total concentration, C is encoded using table 2 with 55CoCftCfm CflCyCnFpFs encoded as 55/// ///FpFs and FpFs encoded if possible.

4.3.3.6 When open water is observed, C is encoded as zero (0). CoCftCfmCflCyCn are encoded as zero's (0) in the stages observed and slash's (/) in the unobserved stages. FpFs will be encoded if possible with the remainder of the observation.

4.3.3.7 If there are no growlers, bergy bits, or icebergs present within the entire range of visibility, the group can be deleted.

4.3.3.8 For conformity and to avoid confusion when plotting ice messages it will be understood that the limits of observation reported for 0101 in an observation begins (increases or decreases) at the exact position for that observation and continues until changed by a subsequent observation or unless otherwise indicated in Part II.

4.3.3.9 An undercast observation (00 for 0101) will be taken at the point where an undercast begins and a regular ice observation is taken at the point where an undercast ends. Plain language, such as UNCST, ORBIT and CLIMB will not be used in the body of the code.

4.3.3.10 In order for the plotter to establish the true limits of observation for a track, the message must provide observations with the coordinates and limits of observation at five minute intervals, all turn points and BT drops along the track, and points where observations begin and terminate. Ice groups are not required in turn point or BT drop observations if conditions are described otherwise (see example in aerial sheet Fig 4-2. Additionally, unusual or irregular limits of observation may be reported in Part II of the code if considered significant.

4.3.3.11 The BT temperature group is encoded with the first digit as zero (0) for plus or one (1) for minus; second, third, and fourth digits in tens, units, and tenths; and fifth digit as (C) for celsius or (F) for fahrenheit. If BT is a dud encode DUD// in place of temperature group.

4.3.4 Notes on Part II

4.3.4.1 The order in which lines and features are reported in Part II is:

4.3.4.1.1 Limits of observation (limits of observation will not be reported in Part II if adequately described in Part I).

4.3.4.1.2 Ice edge

4.3.4.1.3 Fast ice

4.3.4.1.4 Concentration boundaries (all significant areas of differing concentrations will be delineated within the following categories:

4.3.4.1.4.1 Less than 1 tenth

4.3.4.1.4.2 1 to 3 tenths

4.3.4.1.4.3 4 to 6 tenths

4.3.4.1.4.4 7 to 9 tenths

4.3.4.1.4.5 10 tenths with openings

4.3.4.1.4.6 10 tenths without openings

4.3.4.1.5 Water features (At the observers discretion, water features may be described through the use of concentration boundaries, or if considered significant, reported using the appropriate code figure in table 8).

4.3.4.2 As many 6LiLiLjLj groups may be reported as required to describe the line or feature. Code figures (table 8) may appear in any order that best describes the line or feature being reported. Example: 61121 60600 indicates a radar (11) ice edge (21) with the ice to the west of the following line (06). Filler (00) is used to complete the last group.

4.3.4.3 Code figure for land (10) will be reported in a 6LiLiLjLj group immediately preceding the QcLaLaLaLa LoLoLoLoLo coordinates for a point on a line which begins and/or ends at land.

Example: 62111 60110 77435 05715 77515 05930 77550 06300 61000 77555 06620

Ice edge (21), by radar (11), with ice northeast of line (01), from land (10), bounded by 7435N 05715W, to 7515N 05930W, 7550N 00630W, to land (10) 7555N 06620W.

4.3.4.4 Code figures 01-09, which describe direction, need not be used when the concentration within the boundary being described is evident from regular ice observations reported in Part I.

4.3.4.5 When encoding an ice edge, the last coordinates encoded before a 6LiLiLjLj group which changes the designation of the edge from visual to radar or from radar to visual must be repeated after the 6LiLiLjLj group.

Example: 77515 05930 61100 77515 05930

A visual ice edge becoming radar (11) at 7515N 05930W.

Code figure 13 (limits of observation) will be used when the designation of the edge changes from a radar edge to a visual edge.

4.3.4.6 END EDGE will be transmitted immediately following the last QcLaLaLaLa LoLoLoLoLo groups for the ice edge only.

4.3.4.7 Code figure 15 (estimated) when used to describe the line or feature being reported ensures that the data will not be archived but will be available to the ice analysts for evaluation.

4.3.4.8 The supplemental groups (C//// 55CoCftCfmCflCyCnFpFs) need not be reported after the line or feature being described provided the conditions within the feature are evident from ice observations reported in Part I. Encoding the groups is identical to their use in Part I of the aerial ice code. Plain language may be used in place of supplemental groups.

4.3.5. Sample Message Format

UNCLASSIFIED

X 01 02 021530Z MAY 84 PP RR UUUU

NPOC 021130 X

NAVPOLAROCEANCEN ICE OBSERVERS THULE GN

NAVPOLAROCEANCEN SUITLAND MD

INFO NAVOCEANCOMFAC KEFLAVIK IC

ISCOMGREENLAND

COMICEDEFOR KEFLAVIK IC

COMICEASWGRU KEFLAVIK IC

DANISH METEOROLOGICAL INSTITUTE DA

ICE CENTRAL OTTAWA CA

UNCLAS//N03140//

SUBJ AERIAL ICE RECON 02 MAY 1984

1010/ 76516 03200 15500

1011/ 76519 03146 TURN/

1015/ 76538 03125 10350

1018/ 76540 03115 BT001 0010C

1020/ 76557 03108 10200

1025/ 76616 03052 20104 55112 ///34 44223 79052 90101

1030/ 76636 03036 20108 55422 ///45 62424 76254 90201

1035/ 76654 03018 3010A 5542/ /4/54 76413 71171 90702

44111 61121 60800 76602 03326 76558 03300 76603 03133 61300 76603

03133 76602 03123 76604 03115 76602 03100 76605 03050 76603 03037

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X 02 02

UUUU

NPOC 021130 X

62250 60500 76628 03135 76627 03105 76619 03050 76612 03005 62250

END EDGE

60500 76647 03117 76643 03056 76627 03105 05 TO 07 TENTHS FT/FM

61850 60100 76643 03056 76640 03023 76635 03006 76635 02941

FLT KEF TO THULE. THREE PT SIX HRS. NEXT SCHED FLT THULE TO SONDE

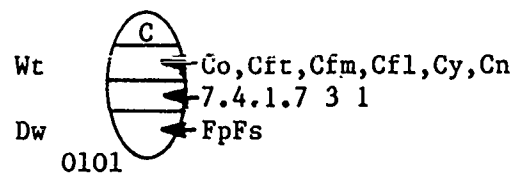
04 MAY 84. NEWLON, SEYMOUR, ROTH.

AG1 P. SEYMOUR USN 3276

UNCLASSIFIED

FIGURE 4-2

4.3.6 Sample Ice Observation Plot



S GGgg ala2
hh h/hx
ms nGnG Re
nBnB

YrYrMMDD QcLaLaLaLa 0101hhc 55CoCftCfmCflCyCnFpFs 9nGnGnBnB

IIHH 840611 1025/ 76616 03052 20104 55112 ///34 44223 79052 90101

GGgg/ LoLoLoLoLo Reala2hhx 7WtDwSms

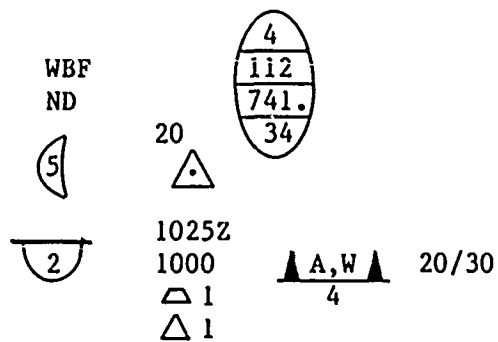


FIGURE 4-3

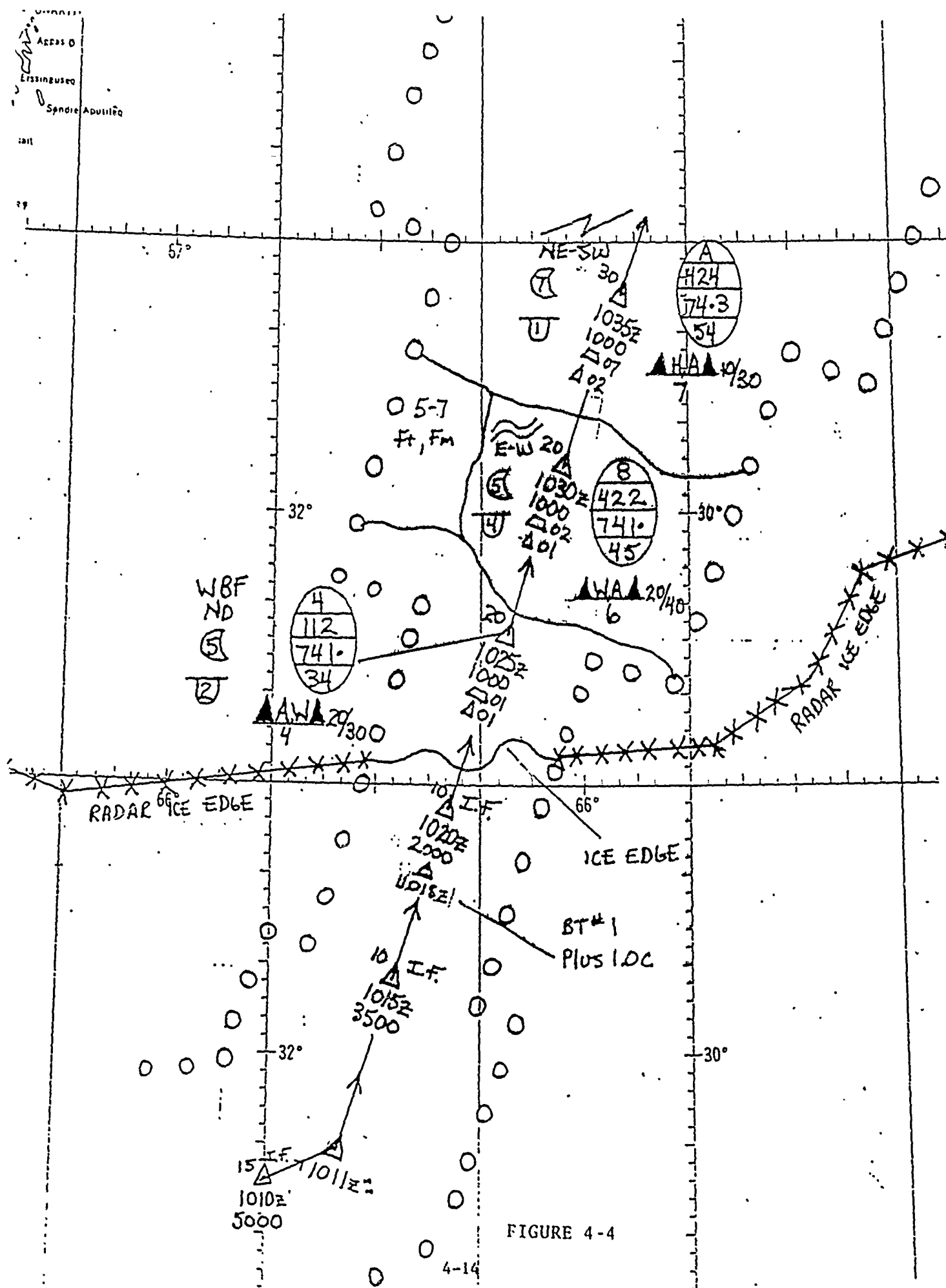


FIGURE 4-4

4.4 PLAIN LANGUAGE ICE OBSERVATION MESSAGE

4.4.1 OBSERVATION DATE/TIME GROUPS: The date/time group that observing was begun and the time observing was secured is given by two standard six figure groups separated by the word "TO". As in all date/time groups, GMT time is used. The interval is referred to as "Ice time" or "Time Over Ice". The date time groups are followed by the month and year of the flight.

EXAMPLE: 121942Z TO 130312Z SEP 1981.

4.4.2 TOTAL FLIGHT TIME: Report the total flight time for the individual flight as recorded on the aircraft's yellow sheet, in word form.

EXAMPLE: SIX PT FOUR. is six hours and 24 minutes flight time.

4.4.3 ALTITUDE: Report the minimum and maximum flight altitude used for observing sea ice.

EXAMPLE: ALT 300 TO 3,000 FT.

4.4.4 LATITUDE AND LONGITUDE: If all latitudes and/or longitudes remain the same along an entire track (e.g. North, West, etc.), a statement regarding this fact should be made in word form. This will inform the plotter/user of this and make any further indication of this throughout the message unnecessary. The latitude/longitude indicators should only be used throughout a message if the track crosses from one quadrant of the globe to another (for quadrants of the globe, see Table 1, Appendix 4 of this manual).

EXAMPLE: ALL LATS NORTH, ALL LONGS WEST.

4.4.5 FLIGHT TRACK: The flight track is reported in order to establish the observed areas. The track is presented as though one were saying: "We went from point "A" to point "B" to point "C" etc.... In the ice message however, the words 'from' and 'to' are understood and are omitted from the message. This rule applies to all lines given in ice messages.

Only those place names which appear on NAVOCEANO ice plotting charts may be used. Geographical coordinates are reported in degrees and minutes. Reported flight tracks contain the following:

- 4.4.5.1 The word "TRK" (track);
- 4.4.5.2 The place name of the departure point (TAKE-OFF PT.);
- 4.4.5.3 The place name or coordinates of a place at or before the point where observations commenced (coastal Departure Point);
- 4.4.5.4 The place names or coordinates of all turning points on the track during the time of observing;
- 4.4.5.5 The place name or coordinates of the place of landfall (coastal Return Point);
- 4.4.5.6 The place name of the termination point.

EXAMPLE: ARGENTIA TWILLINGATE 4930/5530 54/5515 5531/5730 GOOSE BAY.

4.4.6 VISIBILITY RESTRICTIONS LIMITING AREAS OF ICE OBSERVATION:

Restrictions to visibility, such as, fog banks and undercast areas along the track, are reported. If no restrictions are encountered on the flight, no entry concerning restrictions are made in the message.

The limit of observation is reported as a horizontal distance perpendicular to the track and is plotted as dots or circles on either side of and parallel to the track at the distance indicated. Changes are reported by giving a geographic position on the track, followed by the new limit of observation. In all cases, the last reported value will remain in effect until another is given.

EXAMPLE: OB LMT 10 NM 7120/162 BCMG 20 NM 7150/162

Visibility may be different to the port side then the starboard (as when a fog bank parallels one side of the track). In this case, state the word "PORT" followed by the visibility distance, then the word "STBD" (starboard) followed by the visibility distance.

EXAMPLE: OB LMT 20 NM PORT 10 NM STBD 7120/162 BCMG 20
NM 72/162

EXAMPLE OF A HEADING SECTION

In the example below, the numbers in parenthesis preceding each part refer to the reference paragraph in the foregoing text on Plain Language Ice Observation Messages.

(1) 121942Z TO 130112Z SEPT 1981. (2) EIGHT PT TWO. (3) ALT 500 TO 1,500 FT. (4) ALL LATS NORTH, ALL LONGS WEST. (5) TRK EIL PT BARROW 72/153 73/162 ;PT FRANKLIN EIL. (6) OB LMT 10 NM 7210/15242 PORT 15 NM STBD 05NM 7151/153 30NM 7144/15233.

4.4.7 ICE INFORMATION The text of an ice message should be as brief as possible, but it MUST be clear and accurate. This section of the message is encoded toward the direction of flight, and will contain the following information in the sequence indicated. (1) fast ice, (2) ice edges, (3) water features, (4) ice coverage, (5) related features, and (6) related information.

4.4.7.1 Fast Ice This component of the message reports the location and character of all fast ice observed. Report:

4.4.7.1.1 LOCATION: The methods of describing fast ice edges (given below) can be used whenever needed; and can be combined to report a single fast ice area by using the word "THENCE" when changing methods.

4.4.7.1.1.1 Points along a line;

4.4.7.1.1.2 Along a coast with many bays and coves, where only the coastal indentations are fast ice covered; the fast ice edge can be reported as being:

FAST ICE ALL BAYS COVES POINT "A" TO POINT "B"

4.4.7.1.1.3 If the fast ice parallels the shore at a more or less uniform distance, it can be reported as:

FAST ICE THREE NM CSTL POINT "A" POINT "B" ...

4.4.7.1.2 CHARACTERISTICS: In each fast ice area, report the stage or age of the ice.

EXAMPLE: FAST ICE FY CAPE DALEY IS. W TIP LEFFERTS IS. THENCE 2 NM CSTL CAPE CRACROFT.

4.4.7.2 Ice Edge: Ice edges are reported as accurately as possible; although a certain amount of "smoothing" is necessary and desirable. Geographical coordinates are used in establishing all ice edges.

4.4.7.2.1 The method of observation. They will either "VIS" (visually observed) or "RDR" (observed on radar).

4.4.7.2.2 The condition of the ice edge, which may be either:

4.4.7.2.2.1 EDGC (compact or well defined) - the edge of the pack is sharply outlined, with no floes to seaward;

4.4.7.2.2.2 EDGD (diffused) - the edge of the pack is not sharply outlined.

4.4.7.2.3 Report ice edge and the direction the ice lies from the line to be given, i.e. EDGC WEST LN.

4.4.7.2.4 Report points where the ice edge changes from visually to radar observed with the word ""BCMG" preceding the position, i.e. RDR PT "A" PT "B" BCMG VIS EDGC PT "C".

EXAMPLE: RDR EDGC NORTH LN CST 70N/160W 71N/161W BCMG VIS EDGD 72N/163W 72N/165W 73N166W.

4.4.7.3 Water Features: Only major water features which merit individual attention are reported in this part. Fractures, polynyas, and leads will be reported in the ice area containing them. With very large open water or ice free areas in the pack, it is often more convenient to report the feature as a separate area in the ice coverage part. For reported features give:

4.4.7.3.1 Type;

4.4.7.3.2 Location;

4.4.7.3.3 Size;

4.4.7.3.4 Orientation (not applicable to flaw and shore leads);

4.4.7.3.5 Ice condition (omit entry if feature is ice free).

The previous information is not necessarily given in the order presented. Clarity is paramount to a set order.

Remember that flaw and/or shore leads parallel the fast ice edge or shore line by definition. Therefore, these features are located by reporting their beginning and ending points and the average width, unless they are irregular in shape. If they are irregular, describe the location by outlining.

EXAMPLES:

FLAW LEADS

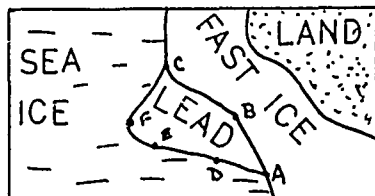


Figure 1.

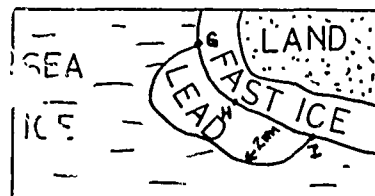


Figure 2.

Figure 1 would be described in an ice message as:

FAST ICE 70/156 (PT "A") 71/155 (PT "B") 7150/153 (PT "C"), FLAW LEAD 70/156 7155/15545 (PT "D") 7130/155 (PT "E") 7145/154 (PT "F") 7150/153.

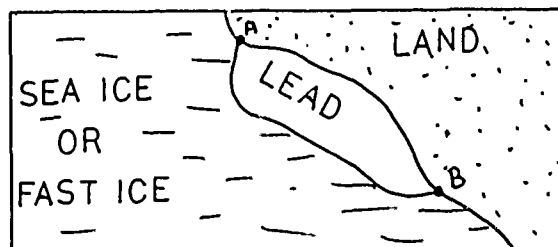
Figure 2 would be described in an ice message as:

2 NM FLAW LEAD N OF LN FM 70/168 (PT "G") 71/169 (PT "H") 7030/170 (PT "I")

SHORE LEADS

SHORE LEAD 2 NM FM 70/163 (PT "A") 72/16410 (PT "B"), OR OUTLINED AS IN FIGURE 1 (WHEN AVERAGE WIDTHS ARE NOT REPRESENTATIVE).

Figure 3.



COMBINED FLAW-SHORE LEAD

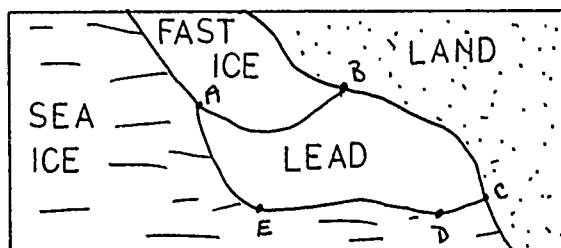


Figure 4.

SHORE LEAD 2 NM CST
70/162 (PT "C") 6950/
16250 (PT "B") BCMG
FLAW LEAD TO 7040/
16410 (PT "A").

LEAD

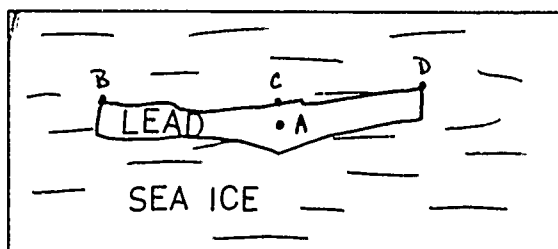


Figure 5

EAST/WEST LEAD 2 X 15
NM CNTRD 70/170 (PT
"A"),

OR

LEAD 2 NM SOUTH OF LN
FM 6958/169 (PT "B")
6958/170 (PT "C") 6958/
171 (PT "D").

LEAD

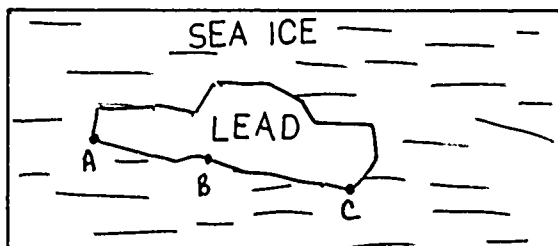


Figure 6.

LEAD 2 NM NORTH OF LN FM
72/160 (PT "A") 72/159
(PT "B") THENCE 5 NM 71/
158 (PT "C").

4.4.7.4 Ice Coverage: All ice observed is reported. This is done by outlining areas of ice and describing the conditions within each area. Minor variations of stage and form, and any variations in topography, stage of melt, and snow cover are not considered sufficient cause to differentiate areas.

Characteristics common to all or most areas are not reported in each area description. These characteristics are combined and reported in the Related Features part of the message. However, concentration and average from description.

4.4.7.4.1 CONCENTRATION AND STAGE: Concentration is reported in tenths for each stage (table 2). Stages are reported using abbreviations (table 11A). In the plain language ice observation message format, concentration and stage is reported by giving a single group containing:

4.4.7.4.1.1 Concentration of predominant stage (number);

4.4.7.4.1.2 Abbreviation for predominant stage (letters);

4.4.7.4.1.3 Concentration of secondary stage (number);

4.4.7.4.1.4 Abbreviation for secondary stage (letters), etc. through as many stages as are present.

EXAMPLE: SMY3FT2N (the total concentration is 10/10)

4.4.7.4.2 FORM: Reported after concentrations and stages using abbreviations in table 10. Report in order of predominance.

EXAMPLE: MF CK (OR) FAST

4.4.7.4.3 TOPOGRAPHY: Reported in tenths and by type. The amount in tenths is for the amount of the ice surface covered by each type. The topography type is written in word form (TABLE 3) followed immediately by the amount in word form

EXAMPLE: RDG TWO HMK ONE RFT ONE

4.4.7.4.4 MEAN AND MAXIMUM HEIGHT OF RIDGING: Reported in meters (table 18).

EXAMPLE: MEAN RDG TWO MAX RDG THREE

4.4.7.4.5 SNOW COVER: Reported in tenths for the amount of ice surface covered by snow. It is reported in word form followed immediately by the amount in word form.

EXAMPLE: SNO SEVEN

4.4.7.4.6 STAGE OF MELT: Reported in tenths and by type. The amount in tenths is for the amount of the ice surface covered by each type. The melt stage is written in word form (TABLE 6) followed immediately by the amount in word form.

EXAMPLE: FPD TWO FTH ONE

4.4.7.4.7 LAND ICE: Reported as type and number (if counted) or as few and many when the exact count is not known. NOTE: Few and many are to be considered relative terms for the situation observed. A guide which may be used is to consider a count of 20 or less as few and a count of greater than 20 as many.

EXAMPLE: FOUR BRG EIGHT BRGY / FEW BRG MNY GRWL

4.4.7.5 Related Features: This part of the text is used to report ice features that the different ice coverage areas have in common.

EXAMPLE: THRUT XCPT NOTED: FT, RDG TWO, FPD TWO, SNO EIGHT, FEW BRGY

4.4.8 Related Information: This component is used to report or summarize information not reported elsewhere in the message, such as:

4.4.8.1 Condition of the sea surface to seaward of the ice edge.

4.4.8.2 Peculiarities or unusual conditions of observations.

4.4.8.3 Shipping support information.

4.4.8.4 Surface ice information (such as snow depth, sea surface temperature, ice thickness etc..., received from surface sources).

4.4.8.5 Future plans of the mission, i.e., next flight scheduled 12 SEP 81.

4.4.8.6 Observer(s) who made the reconnaissance. This is always the last entry of an ice message.

EXAMPLE: OBS DOUBTFUL VCNTY PT "A" DUE DRKNS. BRW OBS ICE THICKNESS 54 IN. NEXT FLT 24 JUN VCNTY CAPE PARRY FITZGIBBON, PONTOW.

4.4.9 Example of complete plain language ice observation message:

UNCLAS//N03140//
SUBJ: AERIAL ICE RECON

1. 121942Z TO 130112Z SEPT 1981. EIGHT PT TWO. ALT 500 TO 1500 FT. ALL
LATS NORTH, ALL LONGS WEST. TRK THULE 79/10 78/05 75/15 7030/16 67/25 TO
KEF. OB LMT 10NM 7030/16 TO 67/25. EDGE 79/1010 7830/12 78/15 76/0710
74/0730 7040/15 6810/22 67/25. N OF LN FM EDGE 78/15 TO 7730/12.
5MY3FT2N MP CK. RDG TWO, HMK ONE, RFT ONE, MEAN RDG TWO, MAX RDG THREE,
SNO SEVEN, FPD TWO, FOUR BRG, EIGHT BRGY, RMDR THRUT XCPT NOTED: 9 FT,
RDG ONE, SNO THREE, FPD ONE, FEW BRGY, OBS DOUBTFUL N OF 79N DUE DRKNS.
THULE OBS ICE THICKNESS 54 IN. NEXT FLIGHT 01 OCT 81. HOLMQUIST, NEWLON.

APPENDIX 1

1.1 STANDARD NAVAL MESSAGE FORMAT

The Standard Naval Message is the primary means of passing sea ice information to the operational user from NAVPOLAROCEN, Suitland, and for passing time critical data from deployed observers to NPOC sea ice analysts for use in operational support. The accuracy of the message and the correct drafting format in accordance with current requirements are essential to effective use of the communication system. Due to the millions of messages transmitted daily, brevity is a major concern. Authorized abbreviations and contractions can be used in composition wherever possible. The following format requirements will aid the drafter in correct message preparation.

1.1.1 PRECEDENCE. The precedence assigned to an ice message indicates the required speed of delivery, in addition to the speed in which it will be acted upon by the addressee(s). The precedence indicators are shown below along with their meanings. Ice observation messages, and analyst/forecast support messages will be designated priority; long-range planning or administrative messages will be designated routine. Immediate precedence may be used if conditions warrant or if the observer has been specifically instructed to do so.

TABLE AP1.1

<u>INDICATOR</u>	<u>PRECEDENCE</u>	<u>SUBJECT MATTER</u>
Z	Flash	Emergency warnings only
O	Immediate	Dangerous storm conditions, ship diversions, etc.
P	Priority	Normal weather conditions, ship movements, and administrative matters requiring immediate attention.
R	Routine	Matters whose urgency does not justify a higher precedence, but to be handled without delay.

1.1.2. DATE/TIME GROUP OF MESSAGE. The date/time group of the message indicates the origination date and time of the message. It is expressed in six digits where, the first two digits indicate the day of the month; the third and fourth indicate the hour; and the fifth and sixth indicate the minutes. If the day of the month is the 9th or earlier, a zero will be used as the first digit in order to complete the six digit group. The six digits are followed by the letter "Z" to indicate Greenwich Mean Time (GMT).

EXAMPLE: 071454Z= the seventh day of the month at 1454Z.

The six digit group is followed by the month and the year.

P 071454Z JAN 85

1.1.3 ORIGINATOR. The originator of the message will be the ice observers from the base or squadron, from which the message is released, or the Command in the case of COMNAVSUPPFORANTARCTICA. Shore stations addresses must be followed by the location of the base. Ship addresses only consist of the name of the ship.

EXAMPLES: FM: COMNAVSUPPFORANTARCTICA

FM: ICE OBSERVERS THULE AB GRNLD

FM: USS ENTERPRIZE

FM: NAVPOLAROCEANCEN SUITLAND MD

1.1.4 ACTION ADDRESSES(S). The activities which are expected to take some action upon receipt of the message are considered action addressees. The action addresses(s) are listed after the word (TO:).

EXAMPLES:

TO: NAVPOLAROCEANCEN SUITLAND MD
USCGC POLAR STAR

1.1.5 INFORMATION ADDRESSE(S). The activities which require knowledge of the message contents but no action is required of their command are info addressees. The information addressee(s) are listed after the word (INFO:).

EXAMPLE:

INFO: NSF POLAR WASHINGTON DC
COAST GUARD SEVENTEEN JUNEAU AK

1.1.6 ACCOUNTING DATA. Accounting Data is only required at the COMM Center in McMurdo Antarctica. It provides for billing of costs within their communication system. It is located directly beneath the addresses.

EXAMPLE: ACCT NSOPP NS-WCAB

1.1.7 CLASSIFICATION. The security classification of a message is based upon the message content. Most ice messages are of an unclassified nature and should be so designated. Specific instructions will be provided if a higher level of classification is required. A classification indicator is required of each paragraph within a message designating the classification of material discussed within that paragraph. Messages which are totally unclassified do not require paragraph classification indicators. All classified messages will require a DECLAS date or Originator Authorization for Declassification Required (OADR), in accordance with current instructions, located on the last line of the message.

SAMPLE MESSAGE:

P131200Z JAN 85

FM: USS POLARBOUND
TO: NAVPOLAROCEANCEN SUITLAND, MD
COMCIVLANT
INFO: COMCIVPAC
BT
CONFIDENTIAL //N03140//
SUBJ: ICE HOCKEY
1.(C) THE GAME IS ON.
2.(U) ICE BERG SIGHTED AT 70N/011E.
DECLAS OADR
BT

1.1.8 STANDARD SUBJECT IDENTIFICATION CODE (SSIC). The message SSIC number categorizes messages by content. All ice related message traffic will be numbered 3140.

EXAMPLE: //N03140//

1.1.9 PASSING INSTRUCTIONS. Navy Automated Message Processing Systems rely for the most part on certain elements at the beginning of the text such as flagwords, codewords, subject lines and outgoing/incoming message references. These guides assist in the automatic, internal routing of messages. Passing instructions placed in the second line of the text (below the classification line) consisting of office codes/symbols/names will not be used by Navy/Marine Corps/Coast Guard activities except as follows:

1.1.9.1 Messages addressed to non-Navy/Coast Guard activities (e.g., U.S. Army, U.S. Air Force, DOD), that do not contain office symbols as authorized below. (See examples a and b.)

Office Symbols/Codes - Office symbols, code numbers and other subordinate or internal activity designators will not be used in plain language address lines of intra Navy/Marine Corps/Coast Guard messages. However, Navy/Marine Corps/Coast Guard commands are permitted to use office symbols with plain language addresses of other services, agencies or joint commands. Office symbols, when used will be placed immediately following the plain language address of the addressee and will be enclosed within double slants, e.g., //DACSA// (see example c). When multiple office symbols are used they will be separated by a single slant, e.g., //DACSA/DACDB//. In cases where the use of office symbols result in the addressee line extending beyond one 69 character line in a message heading, they will be continued on a subsequent line by indenting 5 spaces and beginning at tab stop 25.

EXAMPLES:

- (a) FM: NAVPOLAROEANCEN SUITLAND MD
TO: COMNAVSUPPPFORANTARCTICA
BT
UNCLAS//NO3140//
*PASS TO CASEY STATION
SUBJ: SEA ICE CONDITIONS 55E-115E
- (b) FM: NAVPOLAROEANCEN SUITLAND MD
TO: SCRIPPS INSTITUTE OF OCEANOGRAPHY LA JOLLA CA
BT
UNCLAS//NO3140//
PASS TO PROF W. SMITH; R/V MELVILLE
SUBJ: SEA ICE CONDITIONS 80W-20E
- (c) FM: NAVPOLAROEANCEN SUITLAND MD
TO: 30WS SEOUL KOREA//DO//
BT
UNCLAS//NO3140//
SUBJ: SEA ICE CONDITIONS 90W-20W

(d) FM: NAVPOLAROEANCEN SUITLAND MD
TO: COMNAVSUPPPFORANTARCTICA
BT
UNCLAS//N03140//
SUBJ: SEA ICE CONDITIONS 160E-160W
*1. PASS TO NAVPOLAROEANCEN ICE OBSERVER

* If more than one Action Addressee identify command to pass instructions. Example: COMNAVSUPPPFORANTARCTICA PASS TO NAVPOLAROEANCEN ICE OBSERVER.

1.1.10 SUBJECT. The subject identifies the text subject matter.

EXAMPLE: SUBJ: SEA ICE CONDITIONS 130E TO 150E

SUBJ: ICE OBSERVATION

1.1.11 REFERENCES. References are used when addressing a subject in the message which has been previously addressed via message or phone conversation.

EXAMPLE: A. PHONECON BTWN CW04 FLETCHER (NRL)/AG1 CLINE
(NAVPOLAROEANCEN) OF 20AUG84.

NOTAL is used after the reference if only some of the addressee(s) received the reference message.

EXAMPLE: A. COMNAVSUPPPFORANTARCTICA 190230Z NOV 84 (NOTAL)

1.1.12 TEXT. The text of the message will vary dependent on subject matter. The text relative to this handbook will be the plain language ice observation format.

1.1.13 FREQUENTLY USED MESSAGE HEADERS.

1.1.13.1 EAST GREENLAND

FM: NAVPOLAROCEANCEN ICE OBSERVERS SONDRESTROM GN
TO: NAVPOLAROCEANCEN MD
INFO: NAVOCEANCOMFAC IC
ISCOMGREENLAND
COMICEDEFOR KEFLAVIK IC
COMICEASWGRU KEFLAVIK IC
DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA
ICE CENTRAL OTTAWA CA

1.1.13.2 WEST GREENLAND

FM: NAVPOLAROCEANCEN ICE OBSERVERS THULE GN
TO: NAVPOLAROCEANCEN SUITLAND MD
INFO: NAVOCEANCOMFAC IC
DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA
ISCOMGREENLAND
ICE CENTRAL OTTAWA CA

1.1.13.3 WEST ARCTIC

FM: NAVPOLAROCEANCEN ICE OBSERVERS ANCHORAGE AK
TO: NAVPOLAROCEANCEN SUITLAND MD
INFO: ICE CENTRAL OTTAWA CA

1.1.13.4 ANTARCTICA

FM: COMNAVSUPPFORANTARCTICA
TO: ZEN/CASEY STATION ANTARCTICA
INFO: RULKSKD/NAVPOLAROCEANCEN SUITLAND MD
ACCT NSOPP NS-WCAB
BT

*Messages sent from NPOC ice observers in McMurdo are through CNSFA as the observers are acting for CNSFA

1.1.13.5 ADDITIONAL ROUTING CODES

Routing codes should be checked prior to each deployment.
Indicators in current usage are as follows:

RULKSKD/NAVPOLAROCEANCEN SUITLAND MD
RUDISDI/NAVOCEANCOMFAC KEFLAVIK IC
RUDISAB/COMICEDEFOR KEFLAVIK IC
RUDISDP/COMICEASWGRU KEFLAVIK IC
RYCACAA/ISCOMGREENLAND
RCCTSAB/ICE CENTRAL OTTAWA CA
RDFJ/DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA

APPENDIX 2

2.1 EXAMPLES OF WMO SYMBOLOGY

2.2.1 Total Concentration of Sea Ice (C).

<u>Symbol</u>	<u>Concentration</u>
	Ice Free
0	Less than 1/10
1	1/10
2	2/10
3	3/10
4	4/10
5	5/10
6	6/10
7	7/10
8	8/10
9	9/10
9+	More than 9/10, but less than 10/10
10	10/10

2.1.2 Stage of development and thickness. Entries for (SoSaSbScSd) will be made using the associated symbol below for the types and thicknesses of sea ice you wish to represent.

Table 2.1

Numerical classification of sea ice by the International World Meteorological Organization (WMO).

<u>Glossary</u>	<u>Element</u>	<u>Thickness</u>	<u>Symbol</u>
	No stage of development	-	0
2.1	New ice	-	1
2.2	Nilas; ice rind	<10cm	2
2.4	Young ice	10-30cm	3
2.4.1	Gray ice	10-15cm	4
2.4.2	Gray-white ice	15-30cm	5
2.5	First-year ice	30-200cm	6
2.5.1	Thin first-year ice	30-70cm	7
2.5.1a	Thin first-year ice first stage	30-50cm	8
2.5.1b	Thin first-year ice second stage	50-70cm	9
2.5.2	Medium first-year ice	70-120cm	1.
2.5.3	Thick first-year ice	>120cm	4.
2.6	Old ice		7.
2.6.1	Second-year ice	up to 2.5m or more	8.
2.6.2	Multi-year ice	up to 3.0m or more	9.
10.4	Ice of land origin		

On the horizontal line giving SoSaSbScSd only one dot (.) is to be placed to indicate distinction between classes of any ice having a thickness over 70cm (symbols 1. to 9.) from classes with thickness below 70cm (symbols 1 to 9).

Examples:

Sa = 2.5.2)

Sb = 2.5.1) Symbol:

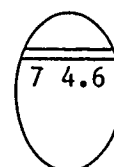
Sc = 2.4)



Sa = 2.6)

Sb = 2.5.3) Symbol:

Sc = 2.5)

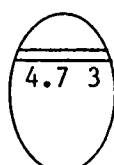


So = 2.6)

Sa = 2.5.3) Symbol:

Sb = 2.5.1)

Sc = 2.4)



Sa = 2.5.1a)

Sb = 2.4.2) Symbol:

Sc = 2.1)



So = 2.5.2)

Sa = 2.5.1a)

Sb = 2.4.2) Symbol: 1.

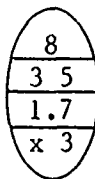
Sc = 2.1)



- (2) The dot-symbol which indicates a distinction between classes of stage of development should be placed midway between the top and the bottom of the figures.
- (3) Thickness figures for old ice, second-year ice, and multi-year ice will be included in this table pending appropriate revision of the International Sea Ice Nomenclature. The separation of thin first-year ice into first and second stages (2.5.1a and b) will also be addressed at the same time.

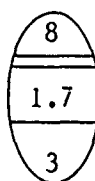
EXAMPLES OF THE USE OF THE "OVAL" SYMBOL

Example 1



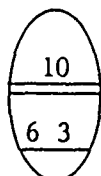
8 tenths of ice; 3 tenths of medium and 5 tenths of thin first-year ice; floe size of medium first-year ice is not known; the floe size of thin first-year ice is small floe.

Example 2



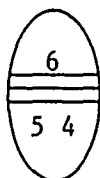
8 tenths of ice; medium and thin first-year ice of which the partial concentrations are not given; predominant floe size is small floe.

Example 3



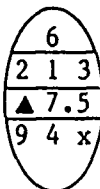
10 tenths of ice; first-year and young ice of which the partial concentrations are not given; no information on form of ice (this example applies particularly to satellite data).

Example 4



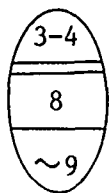
6 tenths of ice in big and medium floes; stages of development not given and therefore there are no partial concentrations.

Example 5



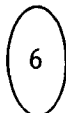
6 tenths of ice; 2 tenths concentration of ice bergs, one tenth of old ice and 3 tenths of gray-white ice; the floe size of old ice is medium floe.

Example 6



3 to 4 tenths of ice; all thin first-year ice of 30 - 50 cm thickness; in strips and patches where the concentration is 9 tenths. (With one stage of development, indication of partial concentration is not needed).

Example 7



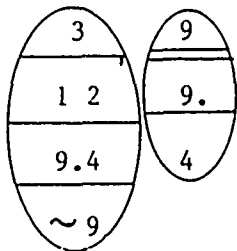
6 tenths of ice; no other details.

Example 8



Less than 1 tenth of ice; some thick first-year ice in small floes is present; some new ice, but total concentration is less than 1 tenth.

Example 9



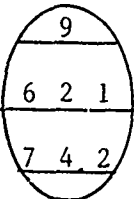
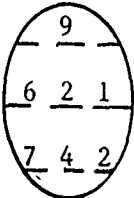
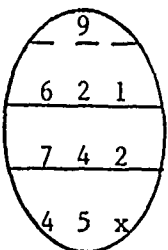
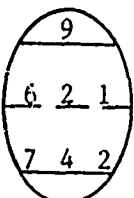
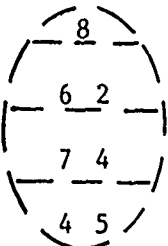
Total concentration is 3/10; 1/10 is multi-year ice; 2/10 is grey ice. The ice is partly distributed in strips and patches within which the concentration is 9/10 of multi-year ice in medium floes.

Example 10



New ice, no concentration or floe size indicated.

In general, throughout the symbology solid line are used for observed data and dashed lines for estimates. For indicating estimates in the "oval," see the following examples.

Symbol	Known Data	Estimated Data	Missing Data
	Concentration, partial con- centrations and stage of development		Floe size
	Concentration	Partial con- centrations and stage of development	Floe size
	Concentration, stage of development. and floe size	Partial concentrations	
	Concentration and partial concentration	Stage of development	Floe size
		All data	

NAVPOLAROCENANCEN ABBREVIATIONS FOR ICE TERMINOLOGY

The below listed endings may be attached to the list of word abbreviations as required to clarify statement interpretation.

al: L	iest, est: ST
ally, erly, ly: LY	iness, ness: NS
ance, ence: NC	ing: G
der: DR	ity: TY
ed, ied: D	ment: MT
ening: NG	ous: US
er, ier, or: R	s, es, ies: S
ern: RN	tion, ation: N
ically: CLY	ward: WD

Word Abbreviations

About: ABT	Across: ACRS
Adjacent: ADJ	Advise: ADV
Again: AGN	Aged Ridge: ARDG
Along: ALG	Amend: AMD
Amount: AMT	Analysis: ANLYS
Area of Weakness: AOW	Around: ARND
Available: AVBL	Average: AVG
Become: BCM	Belt: BLT
Bergy Bit: BRGY	Bergy Water: B/W
Between: BTWN	Big Floe: BF
Boundary: BDRY	Brash Ice: BSH

Break: BRK
Bummock: BMK
Clear: CLR
Cloud: CLD
Compact Ice: CT
Consolidated Ice: CSLD
Continue: CONT
Crack: CRK
Decrease: DCR
Deteriorate: DTRT
Diffuse Ice Edge: EDGD
Distance: DIST
Diverging: DIV
Easy Ice: ESY
Ending: ENDG
Estimate: EST
Expansion: EXPN
Extend: EXT
Farther: FTHR
Fast Ice Boundary: FAST BDRY
Finger Rafted Ice: FRFT
Flaw: FLW
Flaw Polynya: FLW PLYA
Flooded Ice: FLO
Form: FRM
Fracture Zone: FRCTZ

Broken: BKN
Change: CHG
Close Ice: CL
Coast: CST
Concentration: CONC
Consolidated Ridge: CRDG
Cover: CVR
Dark Nilas: DNL
Degree: DEG
Difficult Area: DIFF
Diminish: DMSH
Distant: DSNT
Dried Ice: DRI
Elsewhere: ELSW
Entire: ENTR
Except: EXC
Expect: EXP
Extensive: EXTSV
Fast Ice: FAST
Fast Ice Edge: FEDG
First Year Ice: FY
Flaw Lead: FLW LD
Floe Berg: FB
Forecast: FCST
Fracture: FRCT
Frazil Ice: FZL

Freezing: FZ
Frozen: FRZN
General: GEN
Glacier Berg: GB
Grey Ice: G
Growler: GRWL
However: HWVR
Ice Berg: BRG
Ice Free: IF
Increase: INCR
Information: INFO
Knots: KTS
Latitude: LAT
Light Nilas: LNL
Line: LN
Little Change: LTLCG
Medium First Year Ice: FM
Miles: MI
Move: MOV
Nautical Miles: NM
New Ice: N
Next: NXT
No Change: NC
Number: NR
Observation: OB
On Request: O/R
Open Water: O/W

From: FM
Further: FTHR
Giant Floe: GF
Grease Ice: GRS
Grey White Ice: GW
Heavy: HVY
Hummock: HMK
Ice Cake: CK
Ice Rind: RND
Indicate: INDC
Isolated: ISOLD
Large Fracture: LFRCT
Level Ice: LVL
Limit: LMT
Longitude: LONG
Mainly: MNLY
Medium Floe: MF
Mostly: MSTLY
Multi Year Ice: MY
Near: NR
New Ridge: NRDG
Nilas: NL
Normal: NRML
Numerous: NMRS
Occasional: OCNL
Open Ice: OP
Otherwise: OTRW

Pancake Ice: PK	Plus: PS
Polynya: PLYA	Position: PSN
Possible: PSBL	Predominant: PDMT
Prevail: PVL	Puddle: PD
Rafted Ice: RFT	Rapid: RPD
Recession: RECN	Remain: RMN
Remark: RMK	Ridge: RDG
Ridge Zone: RDGZ	Rotten Ice: ROT
Scattered: SCTD	Second Year Ice: SY
Several: SVRL	Shuga: SG
Significant: SGFNT	Slush: SL
Small Floe: SF	Small Fracture: SFRCT
Small Ice Cake: SK	Snow: SN
Stationary: STNRY	Thaw Hole: TH
Thick: THK	Thick First Year Ice: FT
Thin: THN	Thin First Year Ice: FL
Through: THRU	Throughout: THRUT
Undercast: UNCST	Unknown: UNKN
Until: TIL	Until Further Notice: UFN
Variable: VRB	Vast Floe: VF
Very Close Ice: VC	Very Open Ice: VO
Very Small Fracture: VSFRCT	Very Weathered Ridge: VWRDG
Vicinity: VCNTY	Water: WTR
Weak: WK	Weaken: WKN
Weathered Ridge: WRDG	Widely: WDLY
Will: WL	Will Be Issued: WBI
Wind: WND	Young Ice: YNG
Your: YR	Zone: Z

APPENDIX 4

SHIP-SHORE ICE LOG INSTRUCTIONS

The observer should become fully acquainted with the WMO Sea Ice Nomenclature, which can be found in this manual. Since each observation can make a valuable contribution to the present knowledge of ice, it should be made carefully and thoroughly. Only those conditions present at the time of the observation will be reported. Mandatory and supplemental ice groups will be reported within a one kilometer radius of the observer, called the "spot". See figure A.

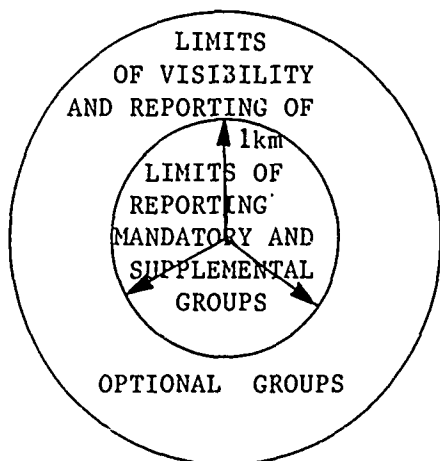


FIGURE A

HOW TO REPORT VISIBILITY

$$\text{AVERAGE VISIBILITY} = \frac{4+2+2+2}{4} = 2.5 \text{ km}$$

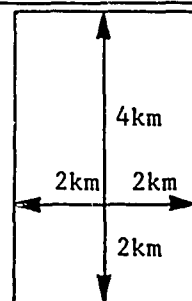
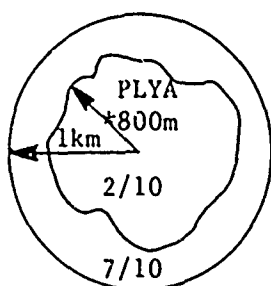


FIGURE B

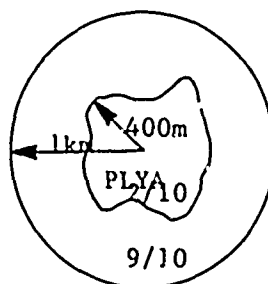
The observer will report any feature seen within the limits of visibility (e.g., the ice edge when surrounded by fairly open water or a polynya or pool when in close ice) using feature groups (see figure A). Visibility is defined as the horizontal distance at which prominent objects can be seen and positively identified by the unaided eye (see figure B).

If the observer is located in a lead or polynya in which the nearest ice boundary is greater than a distance of 700 meters, report the total concentration (C) of the ice within the lead or polynya (see figure C). If the nearest ice boundary is at a distance of less than 700 meters, report the total concentration within the one kilometer radius (see figure D). In both instances, report the polynya or lead using feature groups.



Concentration = 2/10

FIGURE C



Concentration = 6/10

FIGURE D

Follow with feature groups as required to describe all features present. Features near the horizon cannot be accurately estimated and should be ignored. When located in ice free water but within visible limits of an ice edge, or a boundary, report feature groups as necessary to describe the edge or boundary. If it is necessary to use more than one set of feature groups continue on the line directly below, using the appropriate columns.

If radar is available, use radar bearings and distances to determine the position of the ice edge whenever possible. Radar observations are especially valuable if darkness or visibility restrictions make visual observation difficult or impossible.

Latitude and longitude will be reported only by ship stations or operating locations without index numbers. International index and block numbers will be reported only by shore stations.

If no ice is observed within the one kilometer spot, the identifier and location groups will be sent followed by the CFpCpSlCl group coded as 0 (zero). Any remaining groups reported will be feature groups describing ice features outside of the one kilometer area. If no ice is observed because of darkness or poor visibility, the CFpCpSlCl group will be coded as / (slant). In both cases, if radar is available, feature groups based on radarscope interpretation can be sent.

Codes were designed to be used separately from meteorological observations. If, however, it is desired to append the ice data to a meteorological observation of any type, the appropriate identifier group IISS or IILL should follow the weather report, followed immediately by the ice data but omitting the time and location groups.

2. Ship Station

Shipboard observers will make an ice observation at the time the ice edge is first seen; subsequently, an ice observation will be taken four (4) times daily at 00Z, 06Z, 12Z and 18Z while operating in the ice or in view of the ice boundary. One vessel from each convoy will make the ice observation. Additionally, any ship or group of ships separated from the convoy or any ship navigating the ice alone will initiate an observing program. While at sea, the ice observations will be made at the scheduled times regardless of the headway being made. Helicopter reports will be considered as a special shipboard observation. The latitude and longitude of a helicopter observation are particularly important.

3. Shore Station

Shore station observers will make an observation once each day during the navigation season unless otherwise indicated for specific stations, and once a week during the remainder of the year. Latitude and longitude will not be reported by shore stations except when reporting for an operating location which has not been assigned an international index number. These stations will be treated as ships.

4. Special Observations - Ship and Shore

An additional observation will be made when any of the following changes occur:

- a. Change of 3/10 in total concentration;
- b. Change in table 2 from any one of the following groups to any other:
 - 1. Code 0,1,2
 - 2. Code 3,4,5
 - 3. Code 6
 - 4. Code 7,8
 - 5. Code 9
 - 6. Code A,B

MEANING OF SYMBOLS FOR SHIP-SHORE ICE LOG

ai	Trend in behavior of ice (shore stations only). Use table 17.
bi	Ice of land origin. Use table 25.
C	Total concentration of all ice. Use table 2.
Cp	Concentration of predominant form. Use table 2.
Cs	Concentration of secondary form. Use table 2.
Ce	Concentration of the tertiary form of ice. Use table 2.
Cq	Concentration of the quaternary form of ice. Use table 2.
Cu	Concentration of the quintary form of ice. Use table 2.
C1	Concentration of the predominant stage of development of ice. Use table 2.
C2	Concentration of the secondary stage of development of ice. Use table 2.
C3	Concentration of the tertiary stage of development of ice. Use table 2.
C4	Concentration of the quaternary stage of development of ice. Use table 2.
C5	Concentration of the quintary stage of development of ice. Use table 2.
ci	Concentration or arrangement of sea ice. Use table 23.
DE	Ice drift near shore (shore stations only). Use table 16.
DW	Orientation of water feature reported in Wt. Use table 5.
Db	Direction into which water sky or ice blink is observed (ship or shore observations only). Use table 14.
D1	Bearing of principle ice edge. Use table 26.
Et	Type of fast ice (shore stations only). Use table 15.

Fp	Predominant form of ice. Use table 10. If two or more forms of ice have the same concentration, selection of the predominant form will be made in a decreasing size sequence.
Fs	Secondary form of ice. Use table 10.
Fe	Tertiary form of ice. Use table 10.
Fq	Quaternary form of ice. Use table 10.
Fu	Quintary form of ice. Use table 10.
GG	Hour of observation in Greenwich Mean Time.
II	International block number in which station is located (shore stations only).
iii	International station index number (shore station only).
LaLaLaLa	Latitude in degrees and minutes.
Le	Width of shore lead if the horizontal visibility permits (ship or shore observation only).
LiLi	Type of line or feature being described. Use table 8.
LjLj	Type of line or feature being described. Use table 8.
LoLoLoLoLo	Longitude in degrees and minutes.
ms	Stage of melting. Record the stage of melting from table 6 which best describes existing situation. In case of equal stages use higher code figure. NOTE* Few and many are to be considered relative terms for the situation observed and do not refer to any specific surface extent.
nBnB	Number of icebergs within limits of visibility. Use table 7.
nGnG	Number of growlers and bergy bits within limits of visibility. Use table 7.
Qc	Quadrant of the globe. Record the quadrant of the globe in which the observer is located (ship or aerial observation only). Use table 1.
Re	Extent of all ridging. Use table 2.
Rh	Maximum height of all ridging. Use table 18.

S Extent of snow cover (table 2).

Si Stage of developent. Use table 24 for all sea ice.

S1 Predominant stage of development of ice. If two or more stages of development are of the same concentration, older stages of development will have precedence over younger stages. Use table 11A.

S2 Secondary stage of development of ice. Use table 11A.

S3 Tertiary stage of development of ice. Use table 11A.

S4 Quaternary stage of development. Use table 11A.

S5 Quintary stage of development. Use table 11A.

s2 Depth of snow cover on ice (ship or shore ovservation only). Use table 9.

TwTw Water temperature in whole degrees Celsius. Add 50 to temperature below 0 c. (Shore stations only).

T1 Primary type of topography. Report topography of greatest extent. Use table 3. If two types are of equal extent, report higher code number first.

T2 Topography type of second greatest extent. Use table 3.

tE Thickness of ice. If ice of varying thickness, report thickness of the predominant form of ice. Do not include snow depth (ship or shore observation only). Use table 13.

V Visibility (horizontal). When the visibility is irregular or spotty, report the average visibility over the defined area. (Ship or shore observation only) Use table 19.

Wt Type of opening in the ice. If the ice concentration is greater than 80 percent, report the presence of the largest type of opening within the defined area. If less than 80 percent concentration, continue to report the largest type openings other than polynyas. Use table 4.

YY Day of the month.

zi Present ice situation and trend of conditions over preceding three hours. Use table 27.

Appendix 5

TABLES

1. QUADRANT OF THE GLOBE (Qc)

	LATITUDE	LONGITUDE
(1)	NORTH	EAST
(3)	SOUTH	EAST
(5)	SOUTH	WEST
(7)	NORTH	WEST

2. Concentration, Snow Cover, Extent of Ridging (C, Co, Cft, Cfm, Cfl, Cy, Cn, Cl, C2, C3, C4, C5, Cp, Cs, Ce, Cq, Cu, S, Re)

(0)	<1/10	
(1)	1/10	
(2)	2/10	
(3)	3/10	Note: See appendix 1 for Code Table of Total Concentration of Ice (C) used in coding of WMO ICE SYMBOLLOGY.
(4)	4/10	
(5)	5/10	
(6)	6/10	
(7)	7/10	
(8)	8/10	
(9)	9/10	
(A)	10/10 with openings	
(B)	10/10 without openings	

3. TOPOGRAPHY (T1, T2, a1, a2) ABBREVIATIONS

(0)	Level ice	LVL
(1)	New ridges	NRDG
(2)	Weathered ridges	WRDG
(3)	Very Weathered ridges	VWRDG
(4)	Aged ridge	ARDG
(5)	Consolidated ridge	CRDG
(6)	Hummocks	HMK
(7)	Rafted	RFT
(/)	Undetermined or unknown	

4. Type or Opening in the Ice (Wt)

(0)	No openings
(1)	Crack
(2)	Very small fracture (1-50m)
(3)	Small fracture (50-200m)
(4)	Medium fracture (200-500m)
(5)	Large fracture (>500m)
(6)	Lead, shore lead, flaw lead
(7)	Polynya, shore polynya, flaw polynya
(8)	Recurring polynya
(9)	Water between floes
(/)	Undetermined or unknown

5. ORIENTATION (DW)

- (0) No distinct orientation
- (1) Major axis of feature oriented NE-SW
- (2) Orientated E-W
- (3) Orientated SE-NW
- (4) Orientated N-S
- (5) Parallels shore to E
- (6) Parallels shore to S
- (7) Parallels shore to W
- (8) Parallels shore to N
- (/) Undetermined or unknown

6. STAGE OF MELTING (ms) ABBREVIATIONS

- | | |
|-----------------------------|-----|
| (0) No melt | |
| (1) Few puddles | FPD |
| (2) Many puddles | MPD |
| (3) Flooded ice | FLO |
| (4) Few thawholes | FTH |
| (5) Many thawholes | MTH |
| (6) Dried ice | DRI |
| (7) Rotten ice | ROT |
| (8) Few frozen puddles | FFP |
| (9) All puddles frozen | APF |
| (x) Undetermined or unknown | |

7. ICE OF LAND ORIGIN

CRAWLERS, BEROY BITS, AND ICEBERGS (AGnG, uBnB)

- | | |
|-----------|----------------------------|
| (00) None | (16) 16 |
| (01) 1 | (17) 17 |
| (02) 2 | (18) 18 |
| (03) 3 | (19) 19 |
| (04) 4 | (20) 1-9 |
| (05) 5 | (21) 10-19 |
| (06) 6 | (22) 20-29 |
| (07) 7 | (23) 30-39 |
| (08) 8 | (24) 40-49 |
| (09) 9 | (25) 50-99 |
| (10) 10 | (26) 100-199 |
| (11) 11 | (27) 200-499 |
| (12) 12 | (28) 500 or more |
| (13) 13 | (99) No indication because |
| (14) 14 | counting has been |
| (15) 15 | impossible |

8. TYPE OF LINE OR FEATURE BEING DESCRIBED (LiLi,LjLj)

- (00) No specification
- (01) Northeast of following line*
- (02) East of following line*
- (03) Southeast of following line*
- (04) South of following line*
- (05) Southwest of following line
- (06) West of following line*
- (07) Northwest of following line*
- (08) North of following line*
- (09) Within following lines*
- (10) Land
- (11) Radar
- (12) Satellite
- (13) Limits of observation
- (14) Limits of analysis
- (15) Estimated
- (16) Compacted edge
- (17) Diffused edge
- (18) Area of greater concentration
- (19) Area of lesser concentration
- (21) Ice edge
- (22) Concentration boundary
- (23) Fast ice
- (24) Lead
- (25) Polynya
- (26) Belt
- (27) Patch
- (28) Field
- (29) Ridged ice zone
- (30) Fracture zone
- (31) Iceberg
- (32) Scattered icebergs
- (33) Group of icebergs
- (34) Ice island
- (50) Whole visual observed area
- (51) Whole visual observed area outside pack ice area

* The line indicated by the position groups following the group 6LiLiLjLj

NOTE: If only one set of code figure LiLi is used, LjLj shall be coded as 00.

If only one group will provide enough information, drop second 6 group.

9. DEPTH OF SNOW (s2)

- (0) No snow
- (1) up to 5cm
- (2) up to 10cm
- (3) up to 20cm
- (4) up to 30cm
- (5) up to 50cm
- (6) up to 75cm
- (7) up to 100cm
- (8) more than 100cm
- (/) Undetermined or unknown

10. FORMS OF ICE (Fp,Fs,Fe,Fq,Fu,Fa,Fb,Fc)

	<u>Abbreviation</u>
(x) New ice	N
(0) Pancake ice	PK
(1) Small ice cake, brash ice	CK/BSH
(2) Ice cake	CK
(3) Small ice floe	SF
(4) Medium ice floe	MF
(5) Big ice floe	BF
(6) Vast ice floe	VF
(7) Giant ice floe	FG
(8) Fast ice/growlers or floebergs	
(9) Icebergs	
(x) Undetermined or unknown (Used for Fa,Fb,Fc only)	
(/) Undetermined or unknown	

NOTES: (1) The form of new ice is normally not reported when this stage of development occurs as Sa,Sb,or Sc. The symbol "x" undetermined is used (see first variant Chapter 2).

(2) Symbol "8" normally indicates fast ice and is used in conjunction with many stages of development (S). However, when ice of land origin (symbol▲) is reported, the symbol "8" indicates the presence of growlers or floebergs.

11A. STAGES OF DEVELOPMENT (S1,S2,S3,S4,S5)

	<u>Abbreviation</u>
(0) No stage of development	
(1) Frazil ice, grease ice, slush, shuga	N
(2) Ice rind, dark nilas, light nilas	N
(3) Gray ice	G
(4) Gray-white ice	GW
(5) Thin first-year ice	FL
(6) Medium first-year ice	FM
(7) Thick first-year ice	FT
(8) Second year ice	SY
(9) Multi-year ice	MY
(/) Undetermined or unknown	

11.B STAGES OF DEVELOPMENT (So,Sa,Sb,Sc,Sd)

See Appendix 1 page for Code Table and Notes.

12. Width of shore lead (Le)

- (0) Not present
- (1) <100 meters
- (2) 100 meters - <1 kilometer
- (3) 1 kilometer - <2 kilometers
- (4) 2 kilometers - <5 kilometers
- (5) 5 kilometers - <10 kilometers
- (6) 10 kilometers - <30 kilometers
- (7) 30 kilometers - <50 kilometers
- (8) 50 kilometers - <100 kilometers
- (9) 100 or more kilometers
- (/) Undetermined or unknown

13. Thickness of ice (tE)

- (0) <5 cm
- (1) 5 - <10 cm
- (2) 10 - <20 cm
- (3) 20 - <30 cm
- (4) 30 - <40 cm
- (5) 40 - <60 cm
- (6) 60 - <90 cm
- (7) 90 - <150 cm
- (8) 1.5 - <2.5 meters
- (9) 2.5 meters or greater
- (/) Undetermined or unknown

14. Water Sky or Ice Blink (Db)

- (0) Not present
- (1) Ice blink to East
- (2) Ice blink to South
- (3) Ice blink to West
- (4) Ice blink to North
- (5) Water sky to East
- (6) Water sky to South
- (7) Water sky to West
- (8) Water sky to North
- (9) Frost smoke
- (/) Undetermined or unknown

15. Type of Fast Ice

- (0) No fast ice
- (1) Young coastal ice
- (2) Young fast ice
- (3) First-year fast ice
- (4) Second-year fast ice
- (5) Multi-year fast ice
- (6) Icefoot
- (7) Grounded ice
- (8) Stranded ice
- (9) Grounded hummock
- (/) Undetermined or unknown

16. Ice drift near shore (DE)

- (0) No net ice drift
- (1) Ice drift to NE
- (2) Ice drift to E
- (3) Ice drift to SE
- (4) Ice drift to S
- (5) Ice drift to SW
- (6) Ice drift to W
- (7) Ice drift to NW
- (8) Ice drift to N
- (9) All ice is motionless
- (/) Undetermined or unknown

17. Trend in behavior of ice (ai)

- (0) No change
- (1) Ice situation improving (for navigation)
- (2) Ice situation deteriorating (for navigation)
- (3) Ice breaking up
- (4) Ice opening or drifting away
- (5) Ice increasing
- (6) Ice freezing together
- (7) Ice drifting in
- (8) Ice under pressure
- (9) Ice hummocking or screwing
- (/) undetermined or unknown

18. Maximum height of ridging (Rh,h,hx)

- (0) Level ice
- (1) 10 decimeters
- (2) 20 decimeters
- (3) 30 decimeter
- (4) 40 decimeters
- (5) 50 decimeters
- (6) 60 decimeters
- (7) 70 decimeters
- (8) 80 decimeters
- (9) 90 decimeters
- (/) Undetermined or unknown

19. Visibility at surface (V)

- (0) Less than 50 meters
- (1) 50-200 meters
- (2) 200-500 meters
- (3) 500-1000 meters
- (4) 1-2 kilometers
- (5) 2-4 kilometers
- (6) 4-10 kilometers
- (7) 10-20 kilometers
- (8) 20-50 kilometers
- (9) 50 kilometers or more

20. Effect of ice on navigation (K)

- (0) Navigation unobstructed
- (1) Navigation slightly impeded for unstrengthened ships
- (2) Navigation difficult for unstrengthened ships and slightly impeded for strengthened ships
- (3) Navigation difficult for strengthened ships
- (4) Navigation very difficult for strengthened ships
- (5) Navigation possible for strengthened ships only with icebreaker assistance
- (6) Channel open in the solid ice
- (7) Navigation temporarily closed
- (8) Navigation closed
- (9) Navigation conditions unknown, e.g. owing to bad weather

21. Direction (true) toward which ice has drifted in the past 12 hours (D)

- (0) Calm
- (1) Northeast
- (2) East
- (3) Southeast
- (4) South
- (5) Southwest
- (6) West
- (7) Northwest
- (8) North
- (9) All directions
- (/) Undetermined or unknown

22a. Ice accretion on ships (Is)

Code figure

- | | |
|---|---------------------------|
| 1 | Icing from ocean spray |
| 2 | Icing from fog |
| 3 | Icing from spray and fog |
| 4 | Icing from rain |
| 5 | Icing from spray and rain |

22b. Rate of ice accretion on ships (Rs)

Code figure

- | | |
|---|------------------------------------|
| 0 | Ice not building up |
| 1 | Ice building up slowly |
| 2 | Ice building up rapidly |
| 3 | Ice melting or breaking up slowly |
| 4 | Ice melting or breaking up rapidly |

22c. Thickness of ice accretion on ships (EsEs)

- (01) 1 centimeter
(02) 2 centimeters
etc.

23. Concentration or arrangement of sea ice (ci)

- | | | |
|---|--|--|
| 0 | No sea ice in sight | |
| 1 | Ship in open lead more than 1.0 nautical mile wide, or ship in fast ice with boundary beyond limit of visibility | |
| 2 | Sea ice present in concentrations less than 3/10, open water or very open pack ice | Sea ice concentrations are uniform in the observation area |
| 3 | 4/10 to 6/10, open ice | |
| 4 | 7/10 to 8/10, close ice | |
| 5 | 9/10 or more, but not 10/10, very close ice | Ship in ice or within 0.5 nautical mile of ice |
| 6 | Strips and patches of ice with open water between | |
| 7 | Strips and patches of close or very close ice with areas of lesser concentration between | Sea ice concentrations are not uniform in the observation area |
| 8 | Fast ice with open water, very open or open ice to seaward of the ice boundary | |
| 9 | Fast ice with close or very close ice to seaward of the ice boundary | |
| / | Unable to report, because of darkness, lack of visibility, or because ship is more than 0.5 nautical mile away from ice edge | |

24. Stage of development (Si)

- 0 New ice only (frazil, grease, slush, shuga)
- 1 Nilas or ice rind, less than 10 cm thick
- 2 Young ice (grey, grey-white), 10-30 cm thick
- 3 Predominantly new and/or young ice with some first-year ice
- 4 Predominantly thin first-year ice with some new and/or young
- 5 All thin first-year, 30-70 cm thick
- 6 Predominantly medium first-year ice (70-120 cm thick) and thick first-year ice (>120 cm thick) with some thinner (younger) first-year ice
- 7 All medium and thick first-year ice
- 8 Predominantly medium and thick first-year ice with some old ice (usually more than 2 meters thick)
- 9 Predominantly old ice
- / Unable to report, because of darkness, lack of visibility, or because only ice of land origin is visible, or because ship is more than 0.5 nautical mile away from the edge

25. Ice of land origin (bi)

- 0 No ice of land origin
- 1 1-5 icebergs, no growlers or bergy bits
- 2 6-10 icebergs, no growlers or bergy bits
- 3 11-20 icebergs, no growlers or bergy bits
- 4 Up to and including 10 growlers and bergy bits, no icebergs
- 5 More than 10 growlers and bergy bits, no icebergs
- 6 1-5 icebergs with growlers and bergy bits
- 7 6-10 icebergs with growlers and bergy bits
- 8 11-20 icebergs with growlers and bergy bits
- 9 More than 20 icebergs with growlers and bergy bits a major hazard to navigation
- / Unable to report, because of darkness, lack of visibility or because only ice of land origin is visible

26. Bearing of principal ice edge (Di)

- 0 Ship is in shore or flaw lead
- 1 Principal ice edge towards NE
- 2 Principal ice edge towards E
- 3 Principal ice edge towards SE
- 4 Principal ice edge towards S
- 5 Principal ice edge towards SW
- 6 Principal ice edge towards W
- 7 Principal ice edge towards NW
- 8 Principal ice edge towards N
- 9 Not determined (ship in ice)
- / Unable to report because of darkness, lack of visibility, or because only ice of land origin is visible

27. Present ice situation and trend of conditions over
preceding three hours (zi)

- | | | |
|--|---|---------------|
| 0 Ship in open water with floating ice in sight | | |
| 1 Ship in easily penetrable ice; conditions improving | | |
| 2 Ship in easily penetrable ice; conditions not changing | | |
| 3 Ship in easily penetrable ice; conditions worsening; | | |
| 4 Ship in ice difficult to penetrate conditions improving | | |
| 5 Ship in ice difficult to penetrate; conditions not changing | | |
| 6 Ice forming and floes freezing together | } Ship in ice
difficult to
penetrate
conditions
worsening | } SHIP IN ICE |
| 7 Ice under slight pressure | | |
| 8 Ice under slight pressure | | |
| 9 Ship beset | | |
| / Unable to report, because of darkness
or lack of visibility | | |

CONVERSION TABLE

1 Inch =	25.4 Millimeters 2.54 Centimeters
1 Foot =	30.48 Centimeters 3.048 Decimeters 0.3048 Meters
1 Yard =	0.9144 Meters
1 Mile =	1609.3 Meters 1.6039 Kilometers
1 Millimeter =	0.03937 Inches
1 Centimeter =	0.3937 Inches
1 Decimeter =	3.937 Inches
1 Meter =	39.37 Inches 3.2808 Feet 1.0936 Yards
1 Kilometer =	3208.8 Feet 1093.6 Yards 0.62137 Miles 0.54 Nautical Miles

Celsius to Farenheit

$$C = (F - 32) \times (5/9)$$

Farenheit to Celsius

$$F = ((9/5) \times C) + 32$$

APPENDIX 7

NATO ICE ANALYSIS CODE

WMO CODE FM 44-V ICEAN - Ice Analysis Code shall only to be utilized when required by higher authority. The ICEAN code is used to pass sea ice analysis and forecast sea ice information for operational use within NATO.

CODE FORM:

Section 1 ICEAN

(Preamble 1) 20002 33399 0YYGcGc (2YsYsGsGs)

or

(Preamble 2) 75557 33399 0YYGcGc (2YsYsGsGs) 00GpGp

Section 2 44111 6LiLiLjLj QcLaLaLaLa LoLoLoLoLo

QcLaLaLaLa LoLoLoLoLo

CFpCpSlCl (2FsCsS2C2) (3FeCeS3C3) (4FqCqS4C4)

(5FuCuS5C5) (6TlT2ReRh) (7WtDwtEms) (8aIDriri)

(9nGnGnBnB)

Section 3 4422K QcLaLaLaLa LoLoLoLoLo QcLaLaLaLa

LoLoLoLoLo

Section 4 4433K QcLaLaLaLa LoLoLoLoLo QcLaLaLaLa

LoLoLoLoLo

19191

NOTES:

(1) ICEAN is the name of the code describing actual or predicted ice conditions.

(2) An ICEAN analysis or prognosis is identified by the word ICEAN.

(3) The code form is divided into four sections:

Section number	Symbolic figure group	Contents
1	20002 or 75557	Identification and time groups
2	44111	Description of ice conditions
3	4422	Areas with defined navigability
4	4433	Recommended track

Sections 2, 3 and/or 4 are not transmitted seperately.

(4) General

(i) The code name ICEAN shall always appear as a prefix to an individual coded analysis or prognosis.

(ii) When the position groups delineate an enclosed area, they shall appear in the coded analysis in clockwise sequence. The first position group(s) shall be repeated as the last position group(s) to complete closure of the area.

(iii) Each analysis or prognosis shall end with the group 19191.

(5) Section 1

(i) The first preamble shall be used to begin an ice analysis. The second preamble shall be used to begin an ice prognosis.

(ii) The appropriate preamble shall be included each time the analysis or prognosis is prepared from a different chart.

(iii) When, in addition to conventional data, satellite information is used to prepare the analysis or prognosis, the date and time of the satellite information shall be indicated by means of the group 2YsYsGsGs.

(iv) Positions shall be given in degrees and minutes or by using the group LaLaLoLok which give the position to the nearest half-degree. If the group LaLaLoLok is used, the indicator group 33399 in the preamble shall be replaced by the group 33300 for positions in the northern hemisphere and by the group 33311 for positions in the southern hemisphere.

(6) Section 2

(i) Section 2 shall be omitted from the coded analysis or prognosis which is intended to contain only information on the navigability of areas or on recommended shipping tracks.

(ii) Section 2 shall be repeated as often as necessary to describe the ice conditions in the entire area covered by the analysis or prognosis.

(iii) The groups 2FsCsS2C2 etc. 9nGnGnBnB shall be included, as required, to describe further the ice conditions indicated by the preceding groups 6LiLiLjLj etc. CFpCpSlCl.

(iv) Information on icebergs shall be included when available. The group 9nGnGnBnB shall be used to provide information on the icebergs additional to that given by the group 6LiLiLjLj.

(7) Section 3

(i) When information on the navigability of an area is not available, or does not need to be included, Section 3 shall be omitted.

(ii) Section 3 shall be repeated as often as necessary to describe the navigation conditions in the entire area covered by the analysis or prognosis.

(8) Section 4

(i) When information on shipping tracks is not included, Section 4 shall be omitted.

(ii) If the obstruction to navigation varies along a recommended track, Section 4 shall be repeated as often as necessary to delineate the various legs along the recommended track.

(iii) If a recommended track is divided into legs, the position of the last point of the preceding leg shall be repeated as the first position point of the new leg.

Specifications of symbolic code letters

GcGc	Synoptic hour, in GMT, of observation of data from which chart is prepared.
GpGp	Number of hours to be added to GcGc (chart time) to obtain time to which the prognosis refers.
GsGs	Hour (GMT) of observation of the satellite data used for the preparation of the chart.
LaLaLaLa	Latitude in degrees and minutes.
LoLoLoLoLo	Longitude in degrees and minutes.
YY	Day of the month (GMT), with 01 indicating the first day, 02 indicating the second day, etc., indicating the day of the observation of the data, from which the chart is prepared.
YsYs	Day of the month (GMT) of observation of satellite data used for the preparation of the chart.
riri	Distance (nautical miles) travelled by drifting ice in 12 hours.

SEE APPENDIX 5 CODE TABLES FOR REMAINING ICEAN CODE ELEMENTS